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WATER QUALITY INVESTIGATIONS IN THE BLACKFOOT RIVER DRAINAGE, MONTANA

A Report to
the Big Blackfoot River and
Oakbrook, Illinois Chapters
of Trout Unlimited

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SUMMARY

Water quality monitoring was performed in the Blackfoot River drainage to determine if water quality degradation had contributed to a recent decline in the river's fishery and aquatic insect community. Ambient water quality sampling, priority pollutant analyses, chronic toxicity bioassays, and benthic macroinvertebrate surveys were conducted several times during 1988-1989 to characterize water quality and biological integrity throughout the river. In addition, a 49-year record of streamflows was analyzed to assess the influence of extensive logging in the basin on streamflow patterns.

Inputs of mine drainage to the river's headwaters caused the most acute water quality problems identified in the watershed. Toxicity was present, metals concentrations exceeded aquatic criteria, and the benthic community was heavily stressed in eight to twelve miles of the upper Blackfoot River. Less severe effects of historic mining-related impacts were seasonally detectable throughout the river.

Nonpoint sources of suspended sediment and nutrients created seasonal water quality impairment of a chronic nature. The Landers Fork, Nevada Creek, and North Fork drainages appeared to be the largest sources of suspended sediment discharge. Several tributaries, and especially Nevada Creek, were identified as important sources of nitrogen and phosphorus which may have contributed to localized concentrations of nuisance filamentous algae in the Blackfoot. Sediment, nutrients, and the influence of an extended drought caused subtle stresses in the benthic community of the middle reaches of the river.

The Blackfoot River from the North Fork to its mouth had the best water quality and biological conditions of all reaches surveyed.

Analysis of long-term streamflow patterns failed to detect significant changes in timing or volume of runoff over the last half century.

Recommendations were given to correct documented problems and to resolve remaining unanswered questions.

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E Blackfoot River Priority Pollutant Analysis Results

1. INTRODUCTION

The Blackfoot River is a jewel among western Montana streams and a resource precious to thousands of Montanans and nonresidents alike. The Blackfoot is a Class I trout stream in the Montana state fisheries rating system because of its high status in categories of fish production, fish habitat, fish species present, esthetics and public access. It receives some of the heaviest recreational usage in the state and sustains more floating pressure than any river in west central Montana. The Blackfoot drainage is classified B-1 in the Montana water quality standards, which indicates that its high quality waters are capable of supporting all beneficial water uses, including drinking water supplies, swimming and recreation, and growth and propagation of trout. While the beleaguered Clark Fork River, to which it is tributary, has been poisoned with toxic mine wastes, straightened to accommodate highways and railroads, dammed for hydroelectricity, dewatered for irrigated agriculture and replenished with municipal and industrial wastewaters, the Blackfoot drainage has somehow been spared the consequences of development and population growth. Or has it?

In 1987 reports started coming in from long-time fishermen and river residents. Numbers and size of sport fish caught had been decreasing. While Montana Department of Fish, Wildlife and Parks census figures pointed to increasing fishing pressure on the river, and the possibility of overfishing, sportsmen observations also indicated depressed numbers of bottom-dwelling insects in the river. Water quality conditions in the drainage had been extensively inventoried in the past, but only limited work had been performed in the last 15 years. During that time, a host of activities and events had occurred. Extensive logging and road building had taken place on both private and public lands in the basin. The aged Mike Horse mine tailings dam on a headwaters tributary was breached by a flood and its toxic contents were

spilled. Sediment inputs from silvicultural areas, agricultural croplands, overgrazed ranges and placer mines had probably increased. Acid mine drainage continued to enter the upper river from several ancient mine adits. And with a series of unprecedented low streamflow years due to a prevailing drought, the river's ability to flush accumulated sediments and metabolize pollutants was diminished. Perhaps the combined effects of these and other problems had begun to take their toll on the river.

River fans teamed together in 1987 to organize the Big Blackfoot Chapter of Trout Unlimited. The group rallied support and provided impetus for investigations into the Blackfoot's apparently failing health. Private and government money was raised to fund a fisheries study -- the first significant fisheries assessment work since 1975. University of Montana researchers began to explore the consequences of the Mike Horse dam washout and other mining-related problems in the headwaters. The Water Quality Bureau developed a plan of study for a series of water quality and biological investigations to determine if there was a water quality basis for the decline in fish and insect numbers. In the course of two short years, people stopped taking the Blackfoot River for granted. We learned that the river had no magical immunity to man's impact and that it was as fragile as any other river. We also came to realize that the Blackfoot's fishery and aquatic resources were not boundless. Most importantly, it became apparent that we had much to learn about the Blackfoot River before cures could be prescribed. This report is a step in that direction. It describes the results of the Water Quality Bureau's investigations of water quality in the Blackfoot River during 1988-1989. While the scope of our study was broad and did not provide all the answers, it filled an obvious need and was designed to complement the work of other Blackfoot researchers.

There may be no "quick fixes" for the Blackfoot River's ills. But one thing stands clear. People have shown that they are

unwilling to let the Blackfoot River become something less than it was. With an organized body of energetic supporters like the Big Blackfoot Chapter of Trout Unlimited and other concerned sportspersons, the river's future looks bright.

2. OBJECTIVES

The Montana Water Quality Bureau's Blackfoot River study was to determine if there was a water quality basis for the decline in the river's fish and insect communities. Possible causes of impairment included metals from mining activities, sedimentation from agricultural and forest practices, and toxic organics (herbicides, pesticides) from agricultural lands. A study plan was developed (Ingman, 1988) with the following objectives:

1. Establish current ambient water quality conditions in the Blackfoot River during high and low streamflow conditions. Pollutants of concern included heavy metals, algal nutrients, and suspended sediment or turbidity.
2. Determine if chronic toxicity is present in the Blackfoot River during high and low streamflows. While acutely toxic conditions were not suspected, it was possible that sub-lethal concentrations of pollutants were influencing reproductive success or growth rates of resident aquatic life.
3. Characterize the benthic macroinvertebrate community composition and health, determine causes of any documented imbalances, and compare current community structure to that present 15-20 years ago.
4. Document concentrations of organic and other toxic pollutants in the Blackfoot River downstream from major agricultural sub-basins.

During the course of the study, a fifth objective was added. Concerns about possible cumulative effects of intensified timber harvest in the Blackfoot watershed prompted us to evaluate whether

widespread silvicultural activities in the basin had affected 1) the total annual volume of runoff, and 2) the timing of runoff, with consequent effects on 3) water quality in the river and its tributaries.

3. STUDY DESIGN

The monitoring approach consisted of water quality and biological data collection two to three times over a one-year period at up to 14 mainstem monitoring locations (Figure 1). Sample sites were selected to encompass the entire river from its headwaters to near its mouth, to bracket tributary confluences and known or suspected pollutant sources, and to correspond to locations previously sampled (Table 1). The data collection effort consisted of four major elements, described below. The analysis of trends in streamflow patterns over time was accomplished using existing U.S. Geological Survey streamflow data and is discussed at the end of this section. A summary of monitoring activities, frequency and water quality variables measured is given in Table 2. The stations at which each monitoring activity was performed are shown in Table 3.

Ambient Water Quality Surveys

General water quality and concentrations of inorganic pollutants throughout the Blackfoot River had not been characterized since 1972 (Spence, 1975). Our plan called for analyzing concentrations of heavy metals, algal nutrients, suspended sediment or turbidity, and some common ions at each of 14 fixed mainstem monitoring stations. To examine a range of conditions, samples were to be collected once during low summer streamflow conditions in 1988, and again in 1989 following the initial onset of spring runoff, when the river is usually dirtiest. A streamflow of 2500 cubic feet per second (cfs) at the U.S. Geological Survey stream flow gaging station near Bonner was established as the criterion for initiating the runoff monitoring. A third, previously unplanned monitoring run was conducted near the height of spring runoff in May 1989 and included all the major tributaries to the Blackfoot River, as well as 14 mainstem locations. Parameter coverage was reduced at some stations during

the third sampling event.

Chronic Toxicity Bioassays

Bioassays in general are conducted to evaluate the response of a test organism to stream water, wastewater, or prepared solutions of known or suspected toxicants. The seven-day chronic Ceriodaphnia bioassay is useful for determining whether low levels of toxicity may be present in a body of water or an effluent. Ceriodaphnia is a freshwater crustacean more commonly known as a water flea. It is highly sensitive to a number of potential toxicants including ammonia, pesticides and heavy metals. The test is very useful because the effect on the test organisms include synergistic, antagonistic and additive effects of all chemical constituents of a water. Therefore, toxics may be present in concentrations which individually might not be toxic, but which collectively could be significantly toxic.

The Ceriodaphnia bioassay was applied to the Blackfoot River water quality study to screen for toxicity at each of the 14 fixed mainstem monitoring stations on the Blackfoot River. Bioassays were conducted three times during the study -- once during summer 1988 at 15 stations, again in February 1989 at six stations, and thirdly in April, 1989 at a total of 12 stations.

Macroinvertebrate Surveys

The aquatic macroinvertebrate community consists primarily of immature insect forms, including the stoneflies (Plecoptera), mayflies (Ephemeroptera), caddisflies (Trichoptera), true flies (Diptera), beetles (Coleoptera), and others. This group comprises the energy line between the algae, other organic inputs to a stream, and fish. Macroinvertebrates are good indicators of water quality conditions because they have limited mobility, relatively long life spans (up to three years), and are very sensitive to many

forms of environmental degradation. Macroinvertebrates are affected by chemical variables, habitat structure and sediment deposition, food sources, streamflow regimes, and biotic interactions (predation, competition, etc.). The community composition and structure, or biological integrity, reflects the sum of environmental conditions in a stream during the past few months, and to a lesser extent, years. Even if a perturbation has ceased, its effects can often be identified.

Biological and chemical monitoring are complementary approaches to the study of water pollution. Chemical data describe existing conditions but impacts to stream organisms can only be speculated. Biological monitoring documents those impacts.

The Blackfoot River water quality study employed quantitative measurements of the river's macroinvertebrate community structure as an indicator of the biological integrity of the river. A good baseline record of the community was available for the period from 1968 to 1971 (Spence, 1975), although most of that data was for the upper third of the river. We collected replicate samples at each of 14 mainstem stations from the headwaters to near the mouth. Of those 14, seven were the same as those previously sampled. Sampling was conducted once in summer 1988 and a repeat was scheduled for early April 1989. Major spring runoff occurred just prior to the second sampling and it had to be postponed until summer 1989. Seven of the 14 stations were resampled in August 1989, based on the results of the first sampling.

Priority Pollution Screening

To our knowledge, concentrations of toxic organic compounds had never been measured in the Blackfoot River. While problems of this nature were not anticipated in the drainage, we were able to enlist the help of the U.S. EPA regional laboratory in Denver to take a first hand look. Twice during the course of this study,

samples were collected at four mainstem locations -- a control site and three stations located downstream of major agricultural sub-basins in the Blackfoot drainage. The intent was to measure concentrations of toxic organic compounds on EPA's priority pollutant list that might originate from herbicide or pesticide use in the Blackfoot basin. Another objective was to provide additional supporting analyses for the Ceriodaphnia bioassays.

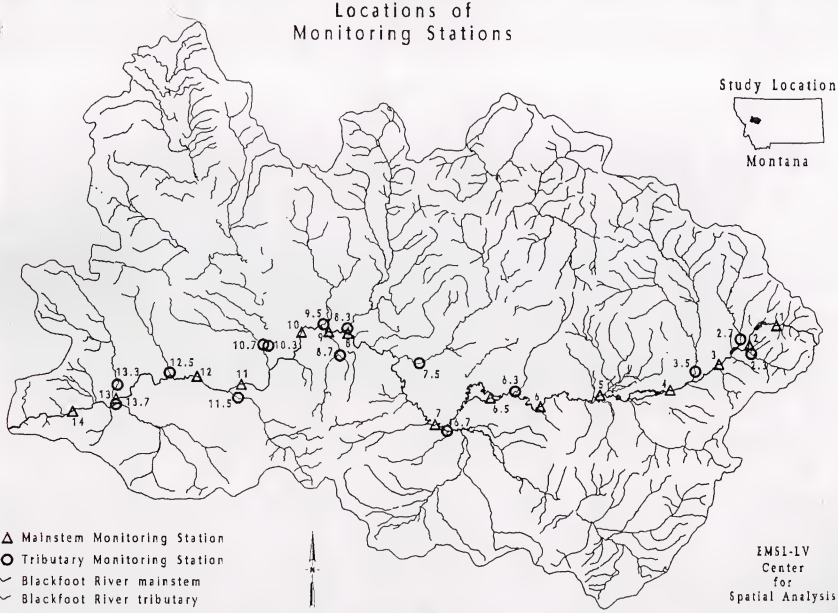
Analysis of Historic Streamflow Patterns

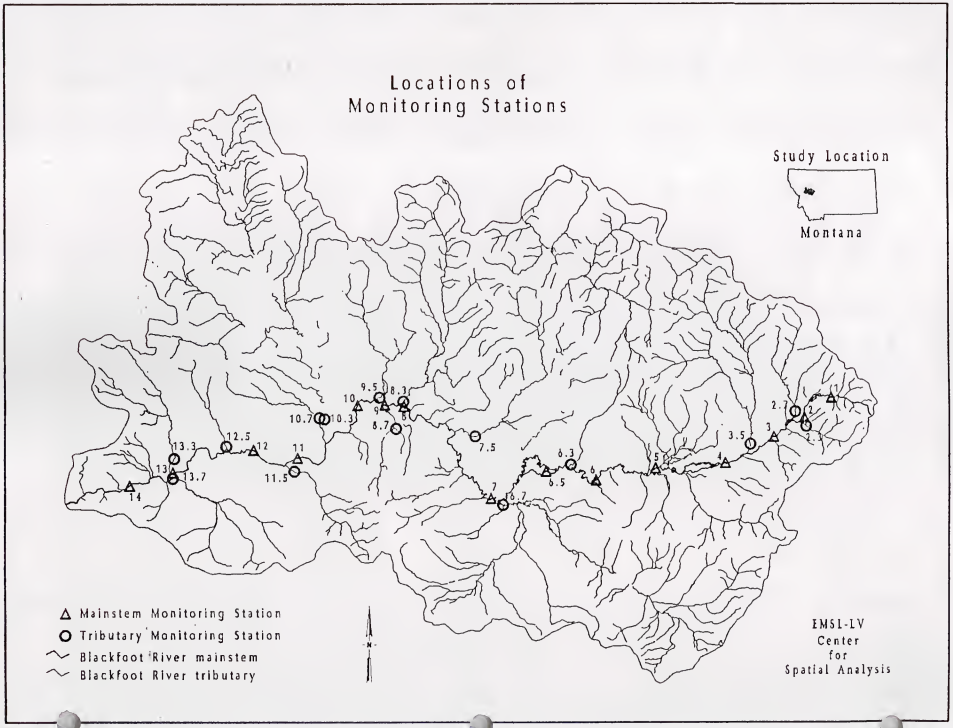
It has long been recognized that forest cultural practices are capable of affecting the quantity, timing and quality of streamflows (Megahan, 1976). In watersheds with extensive silviculture, volume of runoff tends to increase because transpiration is reduced. Timing of runoff is also affected because snowmelt rates are increased by timber harvest, and rainstorms are more likely to produce runoff in logged areas due to higher soil moisture content. Stream temperatures, sediment discharge rates and nutrient concentrations also tend to increase following timber harvest, primarily as a direct result of the removal of vegetation. However, altered streamflows logically contribute to water quality problems as well if nutrient and sediment delivery rates are increased, sediment transport capacities of streams are altered, or decreased streamflows result in elevated water temperatures or less instream dilution of wastewater discharges.

The U.S. Geological Survey has maintained a permanent streamflow gaging station on the lower Blackfoot River near Bonner since 1940. Blackfoot River streamflow data were obtained for the entire 49 year period of record and statistically analyzed to determine if changes had occurred. Total annual water yield from the basin was evaluated as well as the timing of runoff. While historic trends in water quality could not be directly assessed, it was anticipated that an analysis of streamflow patterns would

Figure 1.

Locations of Monitoring Stations




Locations of
Monitoring Stations
Study Location
Montana
Mainstem Monitoring Station
Tributary Monitoring Station
Blackfoot River mainstem
Blackfoot River tributary
N
EMSL-LV
Center
for
Spatial Analysis
1
1.1
2
2.1
2.7
3
3.5
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13
13.3
13.7
14

Table 1. Blackfoot River Monitoring Station Descriptions[1]

Station Number	Station Name	Legal Description	River Mile[1]	Station Rationale
1	Blackfoot River below Meadow Creek	T15N R 6W Sec 20 CB	2.6	Known metals impacts. Station previously sampled by Spence.
2	Blackfoot River at Flesher Pass Road Bridge	T15N R 7W Sec 35 BC	8.2	Known metals impacts. Station previously sampled by Spence.
3	Blackfoot River at Hogum Creek Road Bridge	T14N R 7W Sec 5 DC	12.7	Possible metals recovery and control site above Landers Fork. Station previously sampled by Spence.
4	Blackfoot River between Landers Fork and Lincoln	T14N R 8W Sec 22 BC	18.8	Downstream of Landers Fork. Station previously sampled by Spence.
5	Blackfoot River at Dalton Mountain Road Bridge	T14N R 9W Sec 28 AB	28.2	Downstream of Poorman Creek and Lincoln townsite. Station previously sampled by Spence.
6	Blackfoot River at Nevada-Ogden Road Bridge	T14N R10W Sec 34 BD	37.4	Control site above Nevada Creek. Station previously sampled by Spence.
7	Blackfoot River at Helmville Bridge	T13N R12W Sec 12 AC	66.4	Downstream of Nevada Creek. Suspected agricultural impacts.
8	Blackfoot River above Monture Creek	T15N R13W Sec 34 BA	86.3	Downstream of North Fork Blackfoot River.
9	Blackfoot River below Scotty Brown Bridge.	T15N R13W Sec 32 AB	88.3	Downstream of Monture Creek.
10	Blackfoot River at Sperry Grade fishing access site.	T15N R14W Sec 36 BC	92.4	Downstream of Cottonwood Creek.
11	Blackfoot River at Roundup Bar Bridge	T14N R15W Sec 25 AA	101.9	Downstream of Clearwater River.
12	Blackfoot River at Ninemile Prairie	T14N R15W Sec 20 AD	106.7	Downstream of Elk Creek. Possible mining and agricultural impacts.
13	Blackfoot River at Johnsrud Park	T13N R16W Sec 6 BA	118.8	Control site above Union Creek.
14	Blackfoot River at USGS gaging Station near Bonner	T13N R17W Sec 9 BD	125.1	Downstream of Union Creek. Possible agricultural impacts. Station previously sampled by Spence.

1 Tributary stations sampled on May 11-12, 1989 are listed in Table 3.
2 River mileages from headwaters were computed from Montana Department of Natural Resources and Conservation, 1984.

Table 2. Monitoring Activities, Frequency and Water Quality Variables

---

A. Ambient Water Quality Surveys

The following chemical and physical water quality variables were measured once during low streamflow (August 1988) and high streamflow (April 1989) conditions at each of 14 mainstem monitoring locations:

- o Streamflow[1]
- o Water Temperature
- o pH and alkalinity
- o Water hardness
- o Metals (total recoverable copper, zinc, arsenic, cadmium and lead)
- o Nutrients[2] (dissolved orthophosphate, dissolved nitrate plus nitrite nitrogen, dissolved ammonia nitrogen, total phosphorus, total Kjeldahl nitrogen)
- o Total suspended sediment or turbidity

The following parameters were measured once near the peak of the 1989 spring runoff (May 1989) at each of 14 mainstem and 15 tributary monitoring locations.

- o Metals[3] (total recoverable copper, zinc, arsenic, cadmium and lead)
- o Nutrients (orthophosphate, nitrate plus nitrite nitrogen, ammonia nitrogen, total phosphorus, total Kjeldahl nitrogen)
- o Total suspended sediment

B. Chronic Toxicity Bioassays

The seven-day chronic toxicity Ceriodaphnia bioassay was conducted during summer low streamflow (August 1988), winter low streamflow (February 1989) and spring high streamflow (April 1989) conditions. Testing was done at from six to 15 locations during each bioassay.

C. Macroinvertebrate Surveys

The following biological samples were collected once in August 1988 at each of 14 mainstem locations and again in August 1989 at seven of the original 14 locations[4]:

- o Four quantitative macroinvertebrate samples

Table 2. Continued.

D. The following variables were measured once during low streamflow (August 1988) and high streamflow April 1989) conditions at each of four mainstem monitoring locations[5]:

- o 65 semivolatile organic compounds
- o 36 volatile organic compounds
- o 19 pesticides and PCB-containing compounds
- o 3 chlorinated herbicides

---

1 Streamflows were not gaged in April 1989 because wading was impossible.

2 Total phosphorus and total Kjeldahl nitrogen were not measured in August 1988.

3 Metals measurements were limited to the first four mainstem Blackfoot River monitoring stations and one tributary during May 1989 sampling.

4 August 1989 macroinvertebrate samples have not yet been processed and the results are not discussed in this report.

5 See appendix for specific variables analyzed.

Table 3. Stations at Which Each Monitoring Activity was Performed.

Mainstem Station		Ambient Water Quality Surveys			Chronic Toxicity Bioassays			Macroinvertebrate Surveys		Priority Pollutant Screening	
		August 2-3, 1988	April 8, 1989	May 11-12, 1989	July 29-August 5, 1988	February 10-17, 1989	April 21-28, 1989	August 10-11, 1988	August 10, 1989	August 2-3, 1988	April 24-25, 1989
1	Blackfoot River below Meadow Creek	X	X	X	X		X	X			
2	Blackfoot River at Flesher Pass Road Bridge	X	X	X	X		X	X			
3	Blackfoot River at Hogum Creek Road Bridge	X	X	X	X	X	X	X			X
4	Blackfoot River between Landers Fork and Lincoln	X	X	X	X		X	X	X		
5	Blackfoot River at Dalton Mountain Road Bridge	X	X	X	X	X	X	X			
6	Blackfoot River at Nevada-Ogden Road Bridge	X	X	X	X		X	X	X	X	
6.5_1	Blackfoot River at Highway 271 Bridge			X							
7	Blackfoot River at Helmville Bridge	X	X	X	X	X	X	X	X	X	X
8	Blackfoot River above Monture Creek	X	X	X	X		X	X	X		
9	Blackfoot River below Scotty Brown Bridge	X	X	X	X	X	X	X	X		
10	Blackfoot River at Sperry Grade fishing access site	X	X	X	X			X			
11	Blackfoot River at Roundup Bar Bridge	X	X	X	X	X	X	X		X	X
12	Blackfoot River at Ninemile Prairie	X	X		X			X	X		
13	Blackfoot River at Johnsrud Park	X	X	X	X			X			
14	Blackfoot River at USGS gaging station near Bonner	X	X	X	X		X	X	X	X	X

Table 3. Continued.

Mainstem Station	Ambient Water Quality Surveys			Chronic Toxicity Bioassays			Macroinvertebrate Surveys		Priority Pollutant Screening	
	August 2-3, 1988	April 8, 1989	May 11-12, 1989	July 29-August 5, 1988	February 10-17, 1989	April 21-28, 1989	August 10-11, 1988	August 10, 1989	August 2-3, 1988	April 24-25, 1989
Tributary Station										
2.3 Willow Creek near mouth			X							
2.7 Alice Creek near mouth			X							
3.5 Landers Fork near mouth			X							
6.3 Arrastra Creek near mouth			X							
6.7 Nevada Creek near mouth			X							
7.5 North Fork Blackfoot River near mouth			X	X	X	X				
8.3 Monture Creek near mouth			X							
8.7 East Fork Chamberlain Creek near mouth			X							
9.5 Cottonwood Creek near mouth			X							
10.3 Clearwater River near mouth			X							
10.7 Blanchard Creek near mouth			X							
11.5 Elk Creek near mouth			X							
12.5 Belmont Creek near mouth			X							
13.3 Gold Creek near mouth			X							
13.7 Union Creek near mouth			X							

1 The Blackfoot River at HW 271 was sampled only once, on May 11, 1989.

4. METHODS

4.1 Ambient Water Quality Surveys

Water quality sampling was conducted at each of the 14 mainstem monitoring stations on August 2-3, 1988 during low streamflows and on April 8, 1989, during the first surge of spring runoff. A third sampling run was performed on May 11-12 near the peak of spring runoff and stations included 14 mainstem locations and 15 tributary streams.

Water samples for analysis of metals, nutrients and common ions were grab-sampled in new and/or acid-washed polyethylene bottles at mid-depth in the main current of the river. Samples for suspended sediment analysis were collected in glass bottles with a DH-48 suspended sediment sampler (USGS, 1985) to the limit of wadeability. Water temperatures were measured with a mercury field thermometer having gradations of 1°C and a resolution of 0.1°C. Measurements of pH were made in the field with a portable field pH meter or in the laboratory soon after sampling. Turbidity measurements were made in the lab with a portable field turbidimeter on the same day the samples were collected.

Samples for dissolved nutrient analysis were collected in acid-washed bottles and field-filtered through a glass fiber prefilter and a 0.45µm membrane filter.

All samples were stored on ice and hand carried to the laboratory. Sample collection, handling, preservation and storage procedures followed EPA-approved methods described in MDHES, 1989.

During the initial August sampling run, streamflows were gaged with a Marsh-McBirney Model 2100 water current meter at all locations except station 14. Streamflows for station 14 were obtained from the U.S. Geological Survey for their permanent onsite

gaging station -- the Blackfoot River near Bonner. Streamflows were not measured during April and May because of unwadeable conditions.

All water quality variables except pH and turbidity were analyzed by the Montana Department of Health Chemistry Laboratory Bureau within approved holding times. Measurements included total recoverable metals (copper, zinc, arsenic, cadmium and lead), nutrients (total phosphorus, total Kjeldahl nitrogen, orthophosphate, nitrate plus nitrite and ammonia-nitrogen) total suspended sediment, calcium and magnesium for water hardness determination, and alkalinity.

Sample collection and analysis methods are summarized in Table 4.

A number of procedures were followed in the laboratory and in the field to insure the integrity of data. All apparatus used in collecting and filtering samples for dissolved nutrients was cleaned thoroughly before each reuse. Collection bottles, sample bottles, filter holders, and syringes were soaked for a minimum of several hours in a solution of 25 percent HCl to remove trace concentrations of nitrogen and phosphorous. All apparatus was then rinsed thoroughly with distilled/deionized water.

Bottles for collecting samples for analysis of total phosphorous and total Kjeldahl nitrogen were rinsed three times with ambient water, as were collection bottles for dissolved nutrients. Filters were purged once with a 50 ml aliquot of sample, then again with another 50 ml aliquot which was used to rinse sample bottles. Filter blanks were collected during each sampling episode by collecting, filtering and preserving a quantity of distilled/deionized water following the procedures used for ambient samples. This documented the thoroughness of cleaning techniques and the amount of contamination introduced by sample handling and preservation.

Sample bottles for metals analyses were soaked with a solution of 5% nitric acid for several days to remove any trace concentrations of metals. Immediately before sample collection, bottles were then rinsed three times with ambient water. Preservatives were stored in reusable Teflon ampules to further minimize the possibility of contamination. A field blank was also collected during each sampling episode to document the thoroughness of cleaning techniques and the amount of contamination introduced by sample handling and preservation.

The laboratory maintains a strict quality assurance/quality control program which ensures generated data were of known precision and accuracy. This program involves extensive use of duplicates, spikes, known standards, and EPA audit samples. (MDHES, 1974). Laboratory quality assurance limits and detection limits are summarized in MDHES, 1987.

Ambient water quality measurements were interpreted by comparing the data to published water quality criteria, and to historic records for the Blackfoot River drainage. For some variables, comparisons were also made to data for other Montana rivers.

4.2 Chronic Toxicity Bioassays

The U.S. Environmental Protection Agency (U.S. EPA 1985) has developed a bioassay methodology for detecting ambient toxicity, using the small water flea Ceriodaphnia. A population of organisms, which has been cultured for several weeks in water from a "control" site, is exposed for seven days to water collected from a number of locations along a river. The survival and reproductive success of the population are analyzed to determine where toxicity is present and its relative severity. The survival and

reproduction in the control provide a reference against which responses in other test waters are compared.

Three Ceriodaphnia bioassays were conducted to determine the extent and severity of toxicity which might be present, and to identify possible causes and sources of such toxicity. The study designs of the bioassays differed as to the flow conditions and number of stations tested, and location of the control site. Stations were generally located to bracket major tributaries or suspected pollution sources (Table 1). The first bioassay (July 29 - August 5, 1988) was conducted during summer low flow conditions and used a major tributary (North Fork) as the control because of concern about potential toxicity in the mainstem. The second bioassay (February 10-17, 1989) was intended to confirm findings of the first bioassay. It was performed during winter low flow but tested fewer stations and used a mainstem station as a control. The third bioassay (April 21 - 28, 1989) was conducted during the initial stages of spring runoff to measure the extent and severity of toxicity associated with sediments and their mobilization during high flows, and to determine whether contributions of toxics from nonpoint sources might be more significant than at low flow.

The bioassay begins by isolating test organisms of similar age (4 to 8 hours old) in small beakers of test water. Ten replicates were used for each test water. New test waters were collected every other day. Organisms were transferred to fresh water daily, and fed a small amount of a prepared food. After transferring, mortality and reproduction were tabulated. Data were analyzed using multiple comparisons test developed by Hamilton (1984) and modified by U.S. EPA. In non-toxic waters, three broods of young are normally released by each reproducing organism. Total reproduction is variable, but is commonly 25 to 35 for the total of three broods. Survival is commonly 100%, but incidental mortality is not uncommon.

4.3 Macroinvertebrate Surveys

Four quantitative benthic macroinvertebrate samples were collected at each of the 14 mainstem stations on August 10-11, 1988. Seven of these stations (stations 1-6 and 14) were sampled in 1968-1972. To insure comparability between studies, the square-foot stream bottom sampler used by Spence (1975) was also used in 1988. The sampler was a "Hess type" with a one square foot diameter and 0.45 mm (0.18 in.) mesh netting. A second set of samples was collected on August 10, 1989 at seven of the original 14 locations. These samples have not yet been analyzed.

In the laboratory, samples were stained with rose bengal dye and macroinvertebrates were separated from debris by experienced personnel. To reduce sorting time, most samples were subsampled by dividing the material into equal portions (quarters or eighths) while suspended in a U.S. Standard No. 30 sieve. Two randomly selected portions were then combined to form the subsample (half or quarter of the original sample). A qualitative search for rare taxa in the unpicked portion of the sample was conducted by an experienced entomologist. Identifications were to the lowest practical level, usually genus or species. Most of the taxa identified during this study are included in a reference collection maintained by the Water Quality Bureau.

Several analysis techniques and a variety of parameters were used to evaluate environmental conditions in the Blackfoot River. As the first step of data analysis, similarities in the faunal composition among stations were compared graphically using a single-linkage cluster analysis (Hellawell, 1978) of Percent Community Similarity coefficients (Whittaker, 1975). This analysis identified stations with distinct faunas and provided a biological basis for delineating river reaches.

Community structure and function were characterized for each sample and station using eight indices. Each parameter provided a slightly different measure of the benthic community. Since macroinvertebrates exhibit different responses to various types of environmental stress, some parameters were better indicators of organic enrichment while others were more sensitive to sediment deposition or toxic pollutants. By analyzing an array of indices, the reliability and sensitivity of the overall evaluation was enhanced. The indices used in this analysis were:

macroinvertebrate density
taxa richness
Shannon diversity (Weber, 1973)
biotic index (Hilsenhoff, 1987; McGuire, 1988; Rades, 1988)
EPT richness (Plafkin et. al., 1988)
percentage relative abundance of the dominant taxon (Plafkin et. al., 1988)
percentage relative abundance of filter feeders

Statistical comparisons of these parameters among stations were made using a one-way analysis of variance (ANOVA) and Newman-Keuls multiple range test (Zar, 1974). The usefulness of statistical comparisons was enhanced by performing separate analyses of stations in the upper river (stations 1 through 7) and lower river (stations 8 through 14). To facilitate their use as a baseline for future studies, index values for each sample, for all replicate samples combined, and station means were included. Data from Spence were reanalyzed, and where appropriate, standardized with the present study.

4.4 Priority Pollutant Screening

Sampling for organic and other pollutants on the U.S. Environmental Protection Agency's priority pollutant list was conducted at four mainstem Blackfoot River locations on August 2-

3, 1988, during low streamflow conditions, and on April 24-25, 1989, during high water. Locations initially sampled included 1) the Blackfoot River at the Nevada-Odgen Road Bridge (station 06), which acted as a control location, 2) the Blackfoot River at the Helmville Bridge (station 07), downstream from the Nevada Creek confluence, 3) the Blackfoot River at the Roundup Bar Bridge (station 11), downstream from the Clearwater River, and 4) the Blackfoot River at the USGS gaging station near Bonner (station 14), downstream from Union Creek. During the April sampling, the first station was relocated upstream to the Hogum Creek Road Bridge, to investigate the possibility of seepage from a nearby post and pole treating operation, as well as serving as a control site for the other stations.

Samples were collected in clean, hexane-rinsed glass bottles, stored on ice and delivered within 48 hours of collection to the Special Environmental Analysis Section of the U.S. EPA Region VIII laboratory in Denver, which performed all analyses. Variables measured included 65 semivolatile organic compounds, 36 volatile organic compounds, 19 pesticides and PCB-containing compounds and three chlorinated herbicides.

Analyses were performed using state of the art instrumentation and approved procedures. Quality assurance measures were extensive. Sample collection and analysis methods for priority pollutants are summarized in Table 4.

Analytical results were compared to water quality criteria published by the U.S. EPA (1986) and others.

4.5 Analysis of Historic Streamflow Patterns

Forty-nine years of lower Blackfoot River streamflow data (USGS, 1990) were analyzed to determine whether more recent

silivicultural activities have affected basin hydrology. Hypothetically, large scale land clearing activities could increase the total annual volume of runoff, or alter the timing of runoff.

The Kendal-Tau test (Sanders, et al, 1990) was used to analyze total annual discharge and seasonal (spring, summer, autumn, winter) average discharge. Monthly average flows were used to compute a seasonal average for the three month period defined for each season. The Kendal-Tau tests for a general monotone trend (steady increase or decrease over time). A long period of record is useful for this kind of test because normal climatic variation, such as cycles of wet and dry weather which may affect total annual discharge, or periods of seasonal warming and cooling which affect the timing of runoff, may predominate the analysis over shorter (five- to ten-year) periods of time.

Table 4. Sample Collection and Analysis Methods

Variable	Collection Method	Analytical Method	Laboratory
A. Ambient Water Quality Monitoring			
Streamflow (cfs)	----	Instream field determination[1,2]	Field personnel
Water Temperature (°C)	----	Instream field determination[1]	Field personnel
Turbidity (NTU)	Grab sample	EPA 180.1	Field personnel
pH (standard pH units)	Grab sample	EPA 150.1[3]	Field personnel or MDHES chemistry lab
Alkalinity (mg/l as $CaCO_3$)	Grab sample	EPA 310.2[3]	MDHES chemistry lab
Hardness (mg/l as $CaCO_3$)	Grab sample	EPA 200.7[3]	MDHES chemistry lab
Total Recoverable Metals (ug/l)[4]	Grab sample		MDHES chemistry lab
Copper (TR Cu)		EPA 200.7, 220.2[3]	
Zinc (TR Zn)		EPA 200.7, 289.2[3]	
Arsenic (TR As)		EPA 200.7, 206.2[3]	
Cadmium (TR Cd)		EPA 200.7, 213.2[3]	
Lead (TR Pb)		EPA 200.7, 239.2[3]	
Algal Nutrients (ug/l)[5]	Grab sample		MDHES chemistry lab
Orthophosphate (O-PO4)	Dissolved nutrients field-filtered (0.45um) prior to analysis.	EPA 365.1[3]	
Total Phosphorus (Total P)		EPA 365.1[3]	
Nitrate + Nitrite (NO_3+NO_2 as N)		EPA 353.2[3]	
Total Ammonia (Total NH_3+NH_4 as N)		EPA 350.1[3]	
Total Kjeldahl (Total KJL-N as N)		EPA 351.2[3]	
Suspended Sediment (mg/l)	Effluents grab sampled Streams depth-integrated from shore to limit of wadeability. EWI method[6]		MDHES chemistry lab
Total (TSS)		EPA 106.2[3]	
B. Chronic Toxicity Bioassays			
pH (standard pH units)	4-day composite sample[7]	EPA 150.1[3]	Field personnel
Alkalinity (mg/l as $CaCO_3$)		EPA 310.2[3]	MDHES chemistry lab
Hardness (mg/l as $CaCO_3$)		EPA 200.7[3]	MDHES chemistry lab
Specific Conductance (umhos/cm @ 25°C)		EPA 120.1[3]	MDHES chemistry lab

Table 4. Continued.

Variable	Collection Method	Analytical Method	Laboratory
Total Recoverable Metals (ug/l)[4]	4-day composite sample[7]		MDHES chemistry lab
Copper (TR Cu)		EPA 200.7, 220.2[3]	
Zinc (TR Zn)		EPA 200.7, 289.2[3]	
Arsenic (TR As)		EPA 200.7, 206.2[3]	
Cadmium (TR Cd)		EPA 200.7, 213.2[3]	
Lead (TR Pb)		EPA 200.7, 239.2[3]	
Mercury (TR Hg)		EPA 200.7, 245.1[3]	
Total Ammonia (Total NH_3+NH_4 as N)[5]	4-day composite sample[7]	EPA 350.1[3]	MDHES chemistry lab
C. Macroinvertebrate Surveys			
Benthic Macroinvertebrate Community Structure Parameters	Hess-type round bottom square-foot sampler	Species identifications and counts made using numerous current taxonomic references	Daniel L. McGuire (contractor)
D. Priority Pollutant Screening			
Organic Analyses (ug/l)	Grab sample		U.S. EPA Region VIII chemistry lab (Denver)
Semivolatiles		EPA 625[8]	
Volatiles		EPA 624[8]	
Pesticides and PCBs		EPA 608[8]	
Chlorinated Herbicides		EPA 608[8]	

1 Field procedures for streamflow and water temperature measurements are given in Montana Department of Health and Environmental Sciences, 1989.

2 Streamflows for monitoring stations 1-13 were gaged during August 1988 only. Streamflows for station 14 were obtained from U.S. Geological Survey gaging station records.

3 Inorganic analytical methods are from U.S. Environmental Protection Agency, 1983.

4 Total recoverable metals except mercury were analyzed by carbon furnace methods. Mercury was analyzed by the manual cold-vapor atomic absorption method.

5 Analyses for orthophosphate, nitrate plus nitrite and ammonia were performed on filtered samples in August 1988 and April 1989 and results are dissolved concentrations. Analyses for those variables in May 1989 were as total concentrations (unfiltered samples). All ammonia analyses for the chronic toxicity bioassays were as total concentrations.

6 Water quality samples analyzed to support the 7-day chronic toxicity bioassays were composited from four grab samples collected on days 0, 2, 4, and 6.

7 Suspended Sediment sampling technique (equal-width increment depth-integration) is described in U.S. Geological Survey, 1985.

8 Organic analytical methods are from U.S. Environmental Protection Agency, 1984.

5. RESULTS AND DISCUSSION

5.1 Streamflows

Measured or estimated streamflows for Blackfoot Basin monitoring stations are included in Table 5 and Figure 2. Hydrographs for the U.S. Geological Survey streamflow gaging station, Blackfoot River near Bonner, are presented in Figure 3. The hydrographs give daily mean discharges for the period July 1988 through June 1989 (when this study was conducted), as well as record high, record low and normal streamflows for the period of record (1940-1989).

It had been our intent to document water quality conditions in the Blackfoot River during low and high streamflows, and the 1988-1989 period provided an unusual opportunity to work during both extremes. When the study was initiated in summer 1988, the Blackfoot was experiencing unprecedented low flows. Causes were a low previous winter's snowpack, unseasonably early melt of that snowpack and prolonged periods of well-above-average temperatures. Record to near record low flows were recorded in the river from mid-July through mid-October. In fact, the entire 1988 water year (ending in September 1988) experienced mean streamflows that were only 49 percent of average and which were lower than only two of the 50 years for which records have been kept (USGS, 1989). Streamflows improved over the winter period and approached normal levels. Good snowpack and an early and abrupt spring thaw in spring 1989 produced high to record-high streamflows in the April to mid-May period. This provided an opportunity to monitor river conditions not only during high stream flows, but during the first above-normal flows following several drought years.

Figure 2.

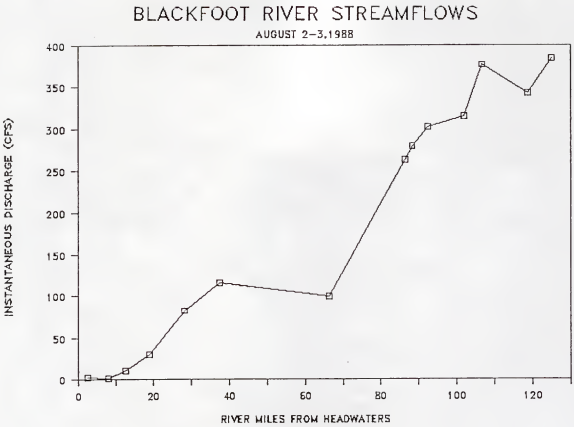
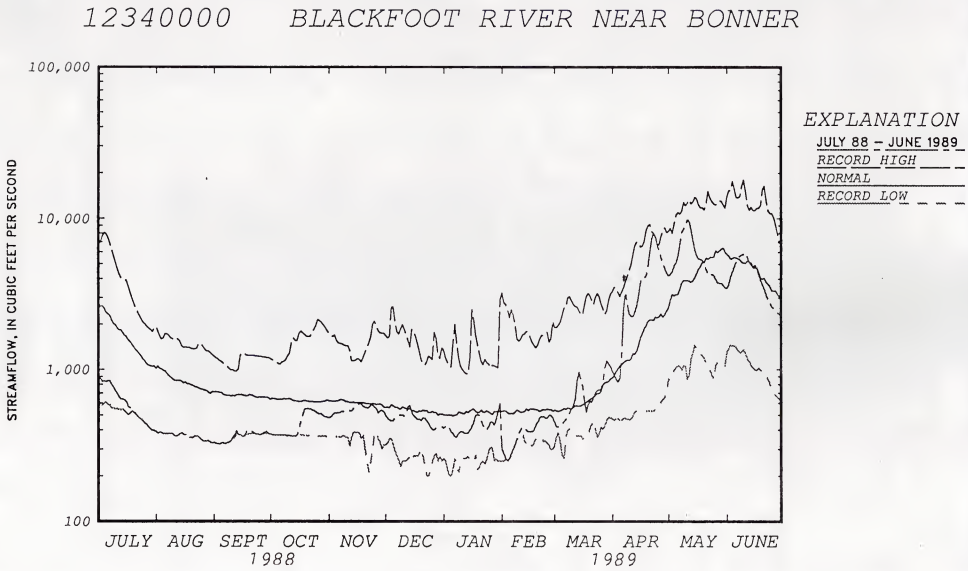

BLACKFOOT RIVER STREAMFLOWS
AUGUST 2-3,1988
INSTANTANEOUS DISCHARGE (CFS)
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100
120
RIVER MILES FROM HEADWATERS

Figure 3.


12340000 BLACKFOOT RIVER NEAR BONNER
STREAMFLOW, IN CUBIC FEET PER SECOND
100,000
10,000
1,000
100
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1988
1989
EXPLANATION
JULY 88 - JUNE 1989
RECORD HIGH
NORMAL
RECORD LOW

5.2 Ambient Water Quality

5.2.1 Common Constituents

Measurements of basic water quality characteristics in the Blackfoot River are given in Table 5. The tables include our monitoring results as well as summaries of other available data. Parameters include pH, alkalinity, hardness and specific conductance. The significance of each parameter is briefly discussed below:

pH - pH is an index of the hydrogen ion activity of a water and is an indirect indicator of acidity or alkalinity. A maximum level of protection is afforded to aquatic life if pH levels do not vary outside the range of 6.5 to 8.5.

Alkalinity - Alkalinity is a measure of the buffering capacity of a water against changes in pH. The major buffering system in natural waters is the carbonate system, which neutralizes acids and bases to reduce fluctuations in pH and serves as a reservoir of carbon for photosynthesis. As a result, the productivity of a water is closely correlated to the alkalinity. No general guidelines are available for acceptable levels of alkalinity. However, unnatural reductions in alkalinity can be expected to reduce the inherent fertility and stability of an aquatic system.

Hardness - Hardness of surface waters is a component of total dissolved solids and is chiefly attributable to the presence of calcium and magnesium ions. Water hardness serves as a general index of water type, buffering capacity, and productivity. Waters high in calcium and magnesium lower the toxicity of many metals to aquatic life. Generally, the biological productivity of a water is directly correlated with its hardness. No specific water quality criteria are available for hardness because other chemical ions, some of which are deleterious, may contribute to hardness.

Specific Conductance - Specific conductance is a simple and widely used, indirect measure of the concentration of dissolved materials in water. The quantity and quality of dissolved solids are major factors in determining the variety and abundance of plants and animals in aquatic systems. A major change in the quantity or composition of total dissolved solids (TDS) changes the structure and function of aquatic ecosystems. Whereas a wide variety of constituents may contribute to the total dissolved solids (or specific conductance), it is not possible to establish specific criteria for aquatic communities. The parameter is most useful as a measure of the relative mineral content of a water.

Measurements of pH, alkalinity, hardness and specific conductance in the Blackfoot River during low and high streamflows are shown graphically in Figures 4-7. Mean values for specific conductance, alkalinity and hardness in the Blackfoot River near Bonner are compared to values for other Clark Fork tributaries in Figure 8 and to other east slope Montana rivers in Figure 9.

Measurements of pH in the Blackfoot River indicated the influence of acid-mine drainage in the headwaters area (Figure 4). While all values were within the optimal 6.5 to 8.5 range, a distinct upward trend was noted with increasing distance from mine adit discharges in the upper river. The more subtle increases which were noted further downstream during the August monitoring were attributable to diel swings in pH caused by river algae metabolism during the day. The marked decrease in river pH which was noted at mile 66 (Helmville Bridge) during the April 8 monitoring run was a result of a sharp increase in streamflow caused by snowmelt runoff from the Nevada Creek drainage. Rainwater and snowmelt runoff is naturally low in pH, dissolved solids and alkalinity. The effect on river pH was spatially short-lived, presumably as a result of the river's buffering capacity.

Alkalinity in the Blackfoot River also responded to the presence of mine drainage in the headwaters (Figure 5). The addition of acid from the Mike Horse Mine and other sources resulted in depressed levels of alkalinity, which were overcome only through increasing dilution by incoming tributaries having more normal alkalinities (note the trend for streamflow in Figure 2). Alkalinities were generally lower during the high streamflow monitoring period, which is to be expected since levels of dissolved solids, including carbonates, are diluted during runoff. A marked increase in alkalinity at mile 28 (Dalton Mountain Road Bridge) indicated the presence of incoming groundwater (springs) or tributaries. The decrease in alkalinity below Nevada Creek on April 8 corresponded to the occurrence of major snowmelt runoff.

Water hardness in the Blackfoot River (Figure 6) showed a similar trend to alkalinity except in the extreme headwaters (Figure 6). Greater hardness at the upper-most monitoring stations resulted from the mine drainage problem. Calcium and magnesium are readily dissolved by weak acid solutions and acid-mine drainage typically has a high hardness. Hardness declined with increasing distance downstream from the mine drainage to the Landers Fork confluence. Changes in water hardness below the Landers Fork and further downstream resulted from the variable hardnesses of incoming tributaries. A notable increase in hardness occurred between Lincoln and the Dalton Mountain Road. This confirms the likelihood of significant inflows of limestone-enriched springs or groundwater, which served to increase the alkalinity and hardness of the Blackfoot River. Hardness was reduced during high flow periods, due to the dilutional effect of runoff water.

Specific conductance in the Blackfoot River indicated moderately low levels of total dissolved solids (TDS) throughout the river and at all times of the year (Figure 7). The enrichening

effect of the Landers Fork was noted during low streamflow conditions. Nevada Creek appeared to increase dissolved solids levels in the Blackfoot River during runoff. However, note that the Spring 1989 specific conductance data are for April 26, rather than April 8, when data for the other variables were measured. Snowmelt runoff had progressed upstream by April 26 and the peak runoff from Nevada Creek was over. Nevada Creek's inflow would have been expected to decrease TDS in the Blackfoot River had measurements been made on April 8.

We can speculate about the Blackfoot River's inherent fertility relative to its potential for plant, insect and fish production if we compare its basic water quality characteristics to those of other Montana rivers. Figure 8 indicates that the Blackfoot River near Bonner has, on the average, slightly higher levels of total dissolved solids (as measured by its specific conductance), alkalinity and hardness then either Rock Creek or the Bitterroot and Flathead rivers near their mouths. Rock Creek and the Bitterroot River are productive trout streams. The Clark Fork at Warm Springs Creek contains substantially higher levels of TDS and water hardness than the Blackfoot River and is a highly productive fishery, although it is very localized due to downstream water quality problems. By comparison to various productive east slope rivers, (Figure 9) the Blackfoot River does not appear to be as inherently rich in water chemistry as some. The Big Horn and Beaverhead Rivers are two of the most productive fisheries in Montana and their waters are rich in dissolved solids, alkalinity and calcium and magnesium. The Blackfoot River is more comparable to the Big Hole or upper Yellowstone rivers, both of which are healthy, productive rivers, although less so than some of the others. We would conclude on the basis of general water quality characteristics alone, that the Blackfoot River fishery should be at least as productive as other tributaries west of the Continental Divide, including Rock Creek. However, due to its moderately low levels of dissolved constituents, alkalinity and hardness, we would

not expect it to support fish densities found in some of the more productive, east slope waters.

Table 5. Blackfoot River Ambient Water Quality Data Summary - Physical Variables and Common Constituents

No.	Station Description	Date	Streamflow (cfs)	Water Temperature (°C)	pH	Alkalinity (mg/l as $CaCO_3$)	Hardness (mg/l as $CaCO_3$)	Specific Conductance (umhos/cm @ 25 °C)	Turbidity (NTU)	TSS (mg/l)
Mainstem Stations										
1	Blackfoot River below Meadow Creek	07-28-88	---	---	7.63	65	152	304	---	---
		08-02-88	2.41	12.4	7.46	66	150	---	2.0	---
		04-08-89	30 (E)	0.3	6.75	32	111	---	5.9	7.5
		04-20-89	---	---	7.31	30	81	179	---	---
		05-11-89	80 (E)	---	---	---	---	---	---	2.6
	Other Data (1968)[1]									
	Range					35- 62	60-160			
	Mean					51	96			
	N=					(8)	(8)			
2	Blackfoot River at Flesher Pass Road Bridge	08-02-88	1.68	12.6	7.82	99	131	---	0.6	---
		08-03-88*	---	---	7.83	99	133	258	---	---
		04-08-89	35 (E)	0.2	7.03	40	100	---	4.7	6.8
		04-26-89*	---	---	7.41	48	85	179	---	---
		05-11-89	105 (E)	---	---	---	---	---	---	1.9
	Other Data (1968-1973)[1]									
	Range					55-125	60-220			
	Mean					80	111			
	N=					(41)	(41)			
3	Blackfoot River at Hogum Creek Road Bridge	08-02-88	10.76	10.2	7.95	115	129	---	0.6	---
		08-03-88*	---	---	7.94	114	132	250	---	---
		02-16-89*	---	---	7.86	---	124	---	---	---
		04-08-89	70 (E)	1.1	7.46	52	85	---	7.6	11.3
		04-26-89*	---	---	7.47	53	74	162	---	---
		05-11-89	80 (E)	---	---	---	---	---	---	2.6
	Other Data (1968-1973)[1]									
	Range					65-125	76-230			
	Mean					107	128			
	N=					(26)	(26)			

Table 5. Continued.

No.	Station Description	Date	Streamflow (cfs)	Water Temperature (°C)	pH	Alkalinity (mg/l as $CaCO_3$)	Hardness (mg/l as $CaCO_3$)	Specific Conductance (umhos/cm @ 25 °C)	Turbidity (NTU)	TSS (mg/l)
4	Blackfoot River between Landers Fork and Lincoln	08-02-88	29.8	10.2	7.99	126	139	---	0.6	---
		08-03-88*	---	---	7.94	125	142	359	---	---
		04-08-89	100(E)	1.5	7.65	62	90	---	8.0	15.7
		04-26-89*	---	---	7.64	74	91	179	---	---
		05-11-89	450(E)	---	---	---	---	---	---	145.
	Other Data (1973)[1]									
	Range					124-133	131-135			
	Mean					128	133			
	N=					(2)	(2)			
5	Blackfoot River at Dalton Mountain Road Bridge	08-02-88	82.7	12.2	8.01	160	178	---	0.7	---
		08-03-88*	---	---	7.94	160	178	326	---	---
		02-16-89*	---	---	8.05	---	174	---	---	---
		04-08-89	150(E)	3.8	7.87	136	152	---	2.0	6.8
		04-26-89*	---	---	7.26	97	112	218	---	---
		05-11-89	---	---	---	---	---	---	---	180.
	Other Data (1968-1973)[1]									
	Range					115-172	102-340			
	Mean					157	171			
	N=					(12)	(12)			
6	Blackfoot River at Nevada-Ogden Road Bridge	08-02-88	115.6	14.2	8.03	158	174	---	0.7	---
		08-03-88*	---	---	7.97	157	175	320	---	---
		04-08-89	250(E)	4.2	7.87	122	138	---	4.7	14.8
		04-26-89*	---	---	7.60	96	115	217	---	---
		05-11-89	---	---	---	---	---	---	---	184.
	Other Data (1968-1973)[1]									
	Range					100-172	103-240			
	Mean					150	161			
	N=					(12)	(12)			
6.5	Blackfoot River at HW271 Bridge	05-11-89	---	---	---	---	---	---	---	210.

Table 5. Continued.

No.	Station Description	Date	Streamflow (cfs)	Water Temperature (°C)	pH	Alkalinity (mg/l as $CaCO_3$)	Hardness (mg/l as $CaCO_3$)	Specific Conductance (umhos/cm @ 25 °C)	Turbidity (NTU)	TSS (mg/l)
7	Blackfoot River at Helmville Bridge	08-02-88	99.2	19.2	8.17	148	164	---	1.6	---
		08-03-88*	---	---	8.06	151	166	308	---	---
		02-16-89*	---	---	7.93	---	161	---	---	---
		04-08-89	500(E)	4.0	7.10	62	104	---	54.	152.
		04-26-89*	---	---	7.68	102	127	243	---	---
		05-11-89	---	---	---	---	---	---	---	209.
8	Blackfoot River above Monture Creek	08-03-88	263.2	14.7	8.13	139	151	---	0.9	---
		08-03-88*	---	---	8.03	135	150	276	---	---
		04-08-89	800(E)	5.2	7.65	53	105	---	77.	213.
		04-26-89*	---	---	7.71	97	104	222	---	---
		05-11-89	---	---	---	---	---	---	---	200.
9	Blackfoot River below Scotty Brown Bridge	08-03-88	278.4	14.6	8.12	128	142	---	0.8	---
		08-03-88*	---	---	8.06	126	138	259	---	---
		02-16-89*	---	---	7.92	---	150	---	---	---
		04-08-89	1000(E)	5.3	7.69	52	99	---	68.	194.
		04-26-89*	---	---	7.34	82	66	191	---	---
		05-11-89	---	---	---	---	---	---	---	196.
10	Blackfoot River at Sperry Grade	08-03-88	302.1	17.5	8.26	129	150	---	1.0	---
		08-03-88*	---	---	8.13	127	141	260	---	---
		04-08-89	1200(E)	5.7	7.73	56	100	---	66.	175.
		05-11-89	---	---	---	---	---	---	---	161.
11	Blackfoot River at Roundup Bar Bridge	08-03-88	315(E)	18.8	8.16	126	140	---	1.1	---
		08-03-88*	---	---	8.04	125	137	254	---	---
		02-16-89*	---	---	7.81	---	136	---	---	---
		04-08-89	2000(E)	5.4	7.75	55	95	---	53.	126.
		04-26-89*	---	---	7.43	71	83	160	---	---
		05-12-89	---	---	---	---	---	---	---	131.

Table 5. Continued.

No.	Station Description	Date	Streamflow (cfs)	Water Temperature (°C)	pH	Alkalinity (mg/l as $CaCO_3$)	Hardness (mg/l as $CaCO_3$)	Specific Conductance (umhos/cm @ 25 °C)	Turbidity (NTU)	TSS (mg/l)
12	Blackfoot River at Ninemile Prairie	08-03-88	376.2	19.1	8.18	126	138	---	1.0	---
		08-03-88*	---	---	8.08	124	137	255	---	---
		04-08-89	2100(E)	5.4	7.75	62	96	---	47.	122.
13	Blackfoot River at Johnsrud Park	08-03-88	342.2	19.6	8.26	123	137	---	0.7	---
		08-03-88*	---	---	8.10	122	134	252	---	---
		04-08-89	2500(E)	5.6	7.73	61	92	---	44.	107.
		05-12-89	---	---	---	---	---	---	---	218.
14	Blackfoot River at USGS station near Bonner	08-03-88	383.6	18.4	8.22	121	134	---	0.8	---
		08-03-88*	---	---	8.09	121	132	249	---	---
		04-08-89	3204.	5.6	7.72	51	83	---	42.	97.
		04-26-89*	---	---	7.57	68	81	157	---	---
		05-12-89	---	---	---	---	---	---	---	180.
	Other Data (1984-1989)[1]									
	Range		200-19200	-0.1-20.5	7.50-8.60	65-147	68-155	131-264		0.4-76.
	Mean		1589	7.4	8.07	107	118	190		9.2
	N=		(2290)	(105)	(78)	(75)	(88)	(17)		(105)
	Other Data (1968-1970)[1]									
	Range					80-148	80-200			
	Mean					128	142			
	N=					(12)	(12)			
Tributary Stations										
2.3	Willow Creek near mouth	05-11-89	40(E)							4.4
2.7	Alice Creek near mouth	05-11-89	80(E)							8.5
3.5	Landers Fork near mouth	05-11-89	400(E)							171.
6.3	Arrastra Creek near mouth	05-11-89	50(E)							21.2
6.7	Nevada Creek near mouth	05-11-89	60(E)							62.7
7.5	North Fork Blackfoot River near mouth	05-11-89	---							160.
8.3	Monture Creek near mouth	05-11-89	---							51.3
8.7	East Fork Chamberlain Creek near mouth	05-11-89	35(E)							37.6

Table 5. Continued.

No.	Station Description	Date	Streamflow (cfs)	Water Temperature (°C)	pH	Alkalinity (mg/l as $CaCO_3$)	Hardness (mg/l as $CaCO_3$)	Specific Conductance (umhos/cm @ 25 °C)	Turbidity (NTU)	TSS (mg/l)
Tributary Stations (Continued)										
9.5	Cottonwood Creek near mouth	05-12-89	100(E)							21.7
10.3	Clearwater River near mouth	05-12-89	---							6.1
10.7	Blanchard Creek near mouth	05-12-89	12(E)							8.0
11.5	Elk Creek near mouth	05-12-89	20(E)							38.3
12.5	Belmont Creek near mouth	05-12-89	17(E)							24.3
13.3	Gold Creek near mouth	05-12-89	150(E)							16.9
13.7	Union Creek near mouth	05-12-89	20(E)							34.2

(E) Indicates estimated streamflow.

* Four-day time-composite samples collected in conjunction with chronic toxicity bioassays.

1 Sources of other data include Spence (1975), Ingman (1987, 1990) and Lambing (1988, 1989).

Figure 4.

BLACKFOOT RIVER pH

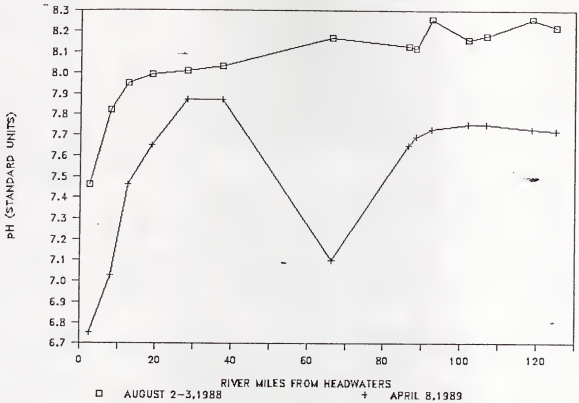


Figure 5.

BLACKFOOT RIVER ALKALINITY

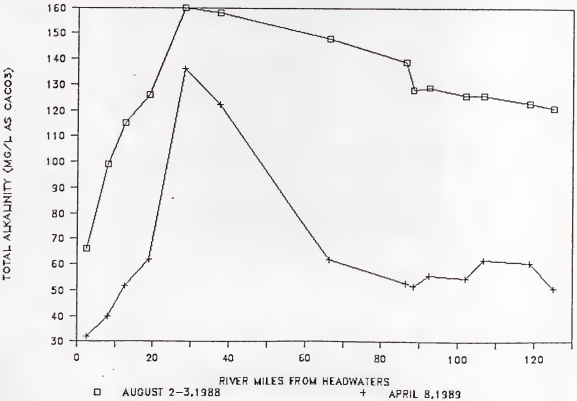


Figure 6.

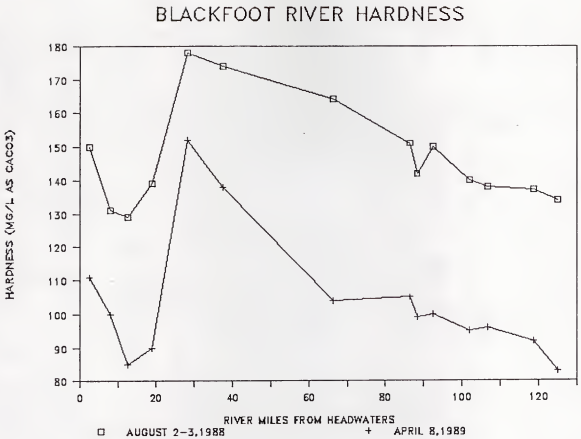


Figure 7.

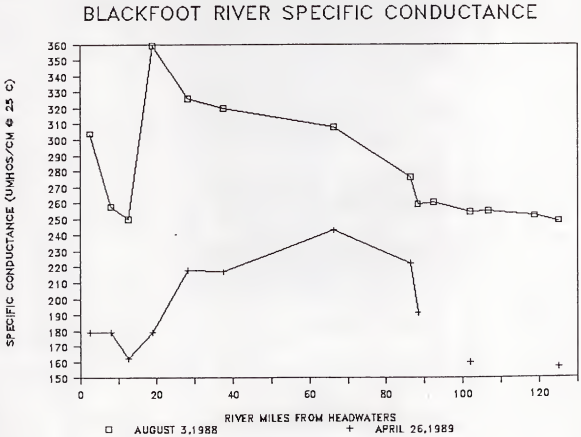


Figure 8.

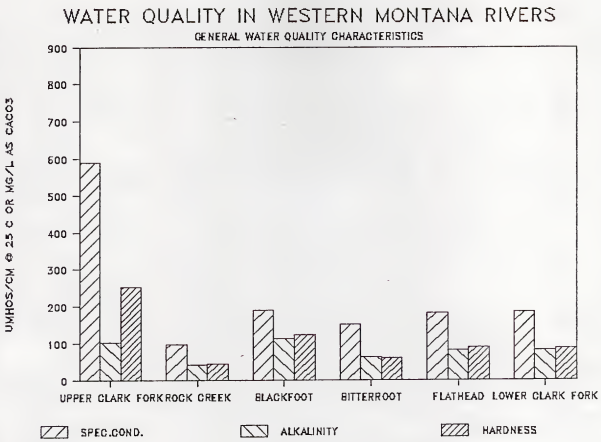
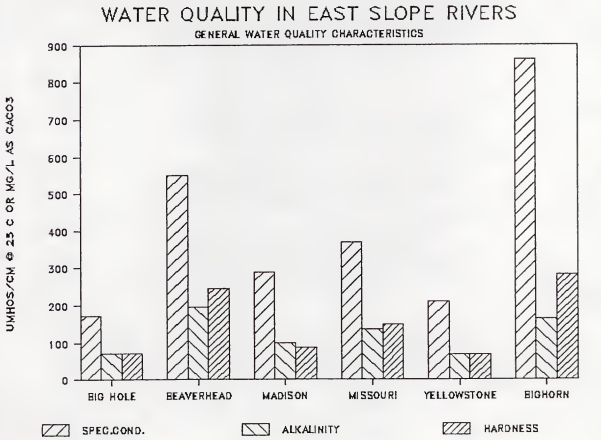


Figure 9.



5.2.2 Suspended Sediment and Turbidity

The weathering of land and transportation of eroded material by water, wind and ice are natural processes that largely determine the characteristics of land, rivers, estuaries and lakes. However, man has greatly increased the rates at which sediments are delivered to waterways by accelerating erosion through various land use practices.

The concentrations and makeup of suspended particles in surface waters are important for a variety of reasons. Increased concentrations of sediments in rivers degrades the appearance of the water and thereby reduces recreational potential and esthetic enjoyment. Less obvious effects of sedimentation are a reduction in light penetration (and hence reduced primary production by aquatic plants), increased stream temperatures (due to absorption of solar energy by sediment particles), and numerous potential impacts on various forms of aquatic life. Sediments may clog the gills of fish and invertebrate organisms, smother developing eggs, reduce the availability of food, and decrease living space for bottom-dwelling fish food organisms.

The Blackfoot River Basin has experienced increased land use over the last several decades. Widespread silvicultural activities on private and public lands in the drainage and associated road construction would be expected to have increased sediment delivery rates to the watershed. Concerns have been raised about the cumulative effects of such activities on the Blackfoot River ecosystem, especially during recent drought years when the river's ability to flush accumulated sediments has been diminished.

Our monitoring effort included the collection of river samples for analysis of turbidity and total suspended sediment. Turbidity is an optical property of a fluid that causes light to be scattered

and absorbed rather than to be transmitted. The amount of turbidity is determined by the concentration of suspended particles, their shape, size, distribution, reflective index, color, and absorption spectra. Thus, turbidity cannot be directly correlated to suspended sediment concentrations. However, it is an inexpensive test that provides a relative measure of water clarity. The Montana water quality standards for B-1 class streams (including the Blackfoot River) specifies a maximum allowable increase in turbidity of five units beyond naturally occurring levels (A.R.M., 1988).

Total suspended sediment or TSS is the total weight of sediment particles, both organic and inorganic, per unit volume in a sample. As was inferred earlier, fish and aquatic life requirements concerning suspended sediments can be divided into: 1) those whose effect occurs in the water column, and 2) those whose effect occurs following sedimentation to the bottom of the waterbody. The European Inland Fisheries Advisory Commission (1965, in U.S. EPA, 1973) states that ". . . there is no evidence that (water column) concentrations of suspended solids less than 25 mg/l have any harmful effects on fisheries; it should be possible to maintain good or moderate fisheries in waters that normally contain 25 to 80 mg/l suspended solids, other factors being equal. However, the yield of fish from such waters might be somewhat lower than from those in the preceding category. Waters normally containing from 80 to 400 mg/l suspended solids are unlikely to support good freshwater fisheries." These are general guidelines only because duration of exposure to various TSS concentrations is not specifically addressed. Quantities of deposited sediments in the Blackfoot River, and their potential effects, are being addressed by the Montana Department of Fish, Wildlife and Parks through substrate composition analysis and embeddedness measurements.

Measurements of turbidity and total suspended sediment in the Blackfoot River and its tributaries are included in Table 5. Figure 10 depicts measured turbidity in the Blackfoot River during August 1988 and April 1989.

During the low, stable streamflows of August, turbidity levels were very low and essentially the same from the headwaters area to near the river's mouth. During the elevated streamflows of April 8, 1989, which corresponded to the first major flush of snowmelt runoff, turbidity levels were very high, especially downstream of Nevada Creek (river mile 66). We observed that major lowland snowmelt runoff in the Blackfoot Basin had progressed upstream about to the area of the Highway 271 bridge. While major flooding was occurring in the Nevada Creek drainage and the Blackfoot was very muddy below its confluence, streamflows remained moderately low and clear in the upper Blackfoot.

On April 8, a further increase in Blackfoot River turbidity was noted downstream from the North Fork confluence (river mile 86). However, the North Fork was observed to be running clear on that date and the increased turbidity could not have been due to that tributary's inflow. The increase probably resulted from channel scouring and a resuspension of accumulated sediments in the Blackfoot River above the North Fork or could have been due to river travel time and our having caught up with a muddier "slug" of water.

Measurements of TSS in the Blackfoot River for April 8 confirm that Nevada Creek was the source of much of the turbidity and sediment load (Figure 11). The trend for TSS on April 8 was nearly identical to that for turbidity.

During the peak streamflows of May 1989, when higher elevation snowmelt was occurring, a different trend was noted (Figure 12).

Concentrations of TSS increased sharply from above to below the Landers Fork Confluence, at river mile 16, indicating that this tributary was an important sediment source whose contribution became most significant later in the runoff period.

A comparison of TSS in 15 tributaries to the Blackfoot River on May 11-12, 1989 indicate that the Landers Fork and North Fork contained the highest concentrations (Figure 13). While the North Fork has been recognized as an important sediment source in the past (Ingman, 1988), its 1989 concentrations may have been relatively greater as a result of the Canyon Creek wild fire of 1988 which resulted in deforestation of much of the North Fork watershed. Due to their large streamflows, the Landers Fork and North Fork probably contributed the largest total discharges (or loads) of sediment to the Blackfoot River during the peak flows of May 1989. While TSS in Nevada Creek during May was also elevated relative to other Blackfoot tributaries, its concentrations were likely but a fraction of those which would have been measured during the observed flooding of April. Nevada Creek appears to be an earlier runoff stream whose sediment impacts to the Blackfoot River are greatest during lowland snowmelt runoff. Nevada Creek appeared to be the single greatest source of TSS and turbidity in the Blackfoot during our April 8 monitoring.

Other tributaries to the Blackfoot, such as Monture Creek, appeared to contain somewhat elevated concentrations of TSS, relative to other tributaries. However, a single runoff sampling event cannot be considered conclusive, due to the variable timing of peak flow events and sediment transport in different tributary drainages of a large watershed.

In summary, most of the total sediment discharge in the Blackfoot Basin occurred during the relatively brief spring runoff period. It seems apparent that the Landers Fork, Nevada Creek, and the North Fork were the three most important contributors of

sediment to the Blackfoot River due to their large streamflows and high TSS concentrations during the runoff period.

Figure 14 is a time-series graph of monthly average total suspended sediment concentrations in the Blackfoot River near Bonner for the period July 1984 through July 1989. This station is monitored as part of the Water Quality Bureau's Clark Fork Basin water quality monitoring network. While the data are somewhat discontinuous, they seem to indicate a trend. During the drought years of 1987 and 1988, suspended sediment concentrations were low, even during spring runoff. In spring 1989, mean TSS concentrations were substantially higher and the duration of elevated concentrations was greater than all other years for which data are available. These data suggest that deposition rates of fine sediments in the Blackfoot drainage may have been greater during the 1987-1988 drought than in earlier periods. The high flows of April-May, 1989 would have been expected to mobilize these accumulated sediments and the resulting greater-than-normal sediment transport was reflected in the TSS measurements.

Figure 10.

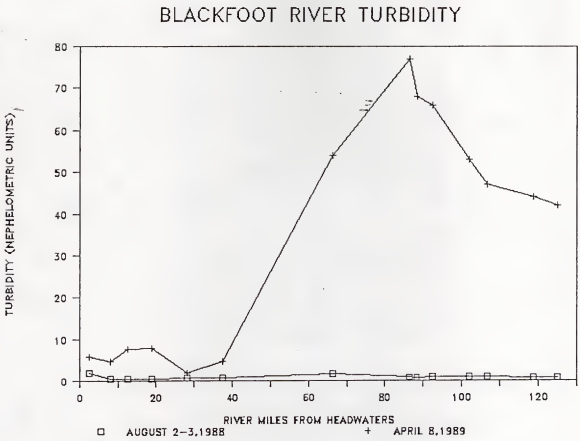

BLACKFOOT RIVER TURBIDITY
TURBIDITY (NEPHELOMETRIC UNITS)
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
RIVER MILES FROM HEADWATERS
AUGUST 2-3,1988
APRIL 8,1989

Figure 11.

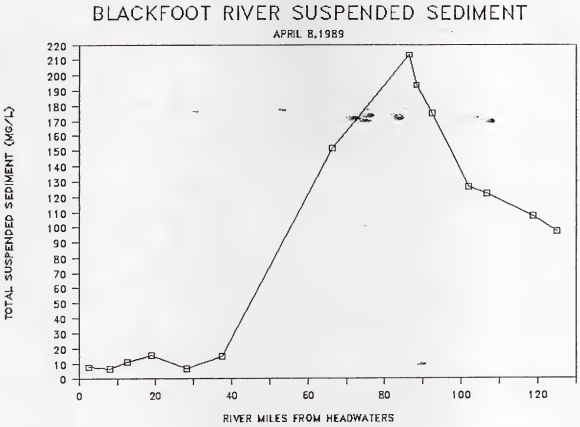


Figure 12.

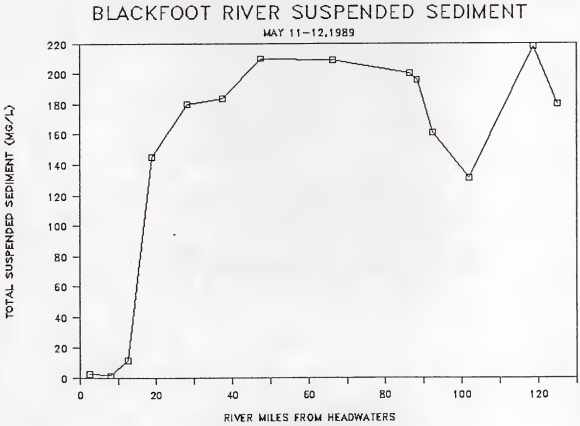


Figure 13.

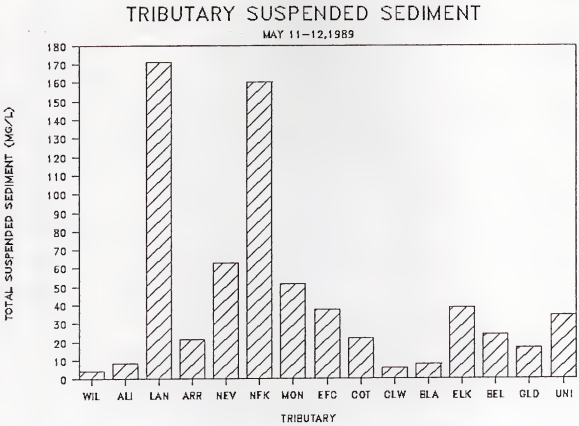
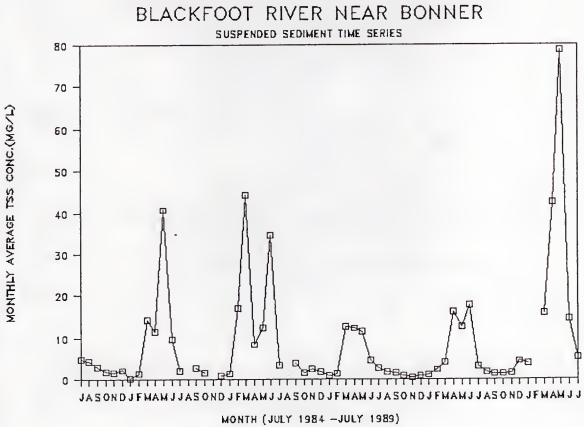


Figure 14.



5.2.3 Heavy Metals

The Blackfoot Basin has a 125-year history of metals mining and milling activities. Heavy metals and acid produced from waste sites associated with former mining operations in the headwaters are the major water quality problem in the upper Blackfoot River.

The U.S. EPA has established criteria values for water column concentrations of copper, zinc, cadmium, lead, and arsenic that should not be exceeded in order to protect sensitive freshwater aquatic organisms. The values are water hardness-dependent for copper, zinc, cadmium and lead and are fixed for arsenic. The criteria give two values -- a chronic toxicity value, expressed as a 4-day average concentration, and an acute toxicity value, expressed as a one-hour average concentration, that should not be exceeded more than once every three years. The chronic toxicity criteria for copper, zinc, cadmium, and lead, at a water hardness of 100 mg/l (as $CaCO_3$), are 12, 110, 1.1, and 3.2 ug/l, respectively. Acute toxicity criteria for the same metals are 18, 120, 3.9 and 82 ug/l, respectively. The fixed chronic and acute toxicity criteria for arsenic are 190 and 360 ug/l, respectively (U.S. EPA, 1986).

Concentrations of heavy metals and EPA toxicity criteria values for Blackfoot Basin monitoring stations are listed in Table 6. The table includes summaries of earlier data collected by Spence (1975) and others, as well as our monitoring results. Figures 15-22 are graphs showing downstream trends in measured water column concentrations of copper, zinc, lead, arsenic and cadmium in the Blackfoot River during low and high streamflow periods, as well as the chronic and acute toxicity criteria values.

During the August 1988 low streamflow monitoring, instream copper concentrations were consistently well below the toxicity

criteria throughout the Blackfoot River (Figure 15). The highest copper concentration (7 ug/l) was measured at the upper-most monitoring location, where the computed chronic toxicity threshold value was 17 ug/l. All other downstream August copper measurements were less than the analytical detection limit of 1 ug/l. Copper toxicity criteria values for the river were variable as a result of differing water hardness from station to station.

During the high streamflows of April 8, 1989, copper concentrations increased at most monitoring stations (Figure 16). Concentrations at the upper-most station were well above both the chronic and the acute criteria values. While copper concentrations at all other river locations were below the criteria, they were elevated relative to August 1988 measurements, indicating that metals from headwaters sources were detectable throughout the length of the river and were more apparent during runoff conditions. Toxicity criteria values were also significantly lower during runoff due to reduced water hardness, resulting in less protection to aquatic organisms. Copper concentrations appeared to increase in the middle to lower river reach during the April 8 monitoring. This is probably not a meaningful trend but one which resulted from variable quality "slugs" of runoff moving downstream from the headwaters, or from the flushing of metals-enriched bottom sediments which had accumulated in the river at various places downstream from their headwaters sources of origin.

Zinc concentrations in the Blackfoot River during low and high streamflow conditions followed a similar trend to copper (Figures 17 and 18). During August 1988, zinc concentrations surpassed both chronic and acute toxicity criteria in the extreme headwaters but quickly dropped to levels below analytical detection. During the April runoff, the zone of effect and magnitude of concentrations was increased substantially, while a reduction in the criteria values exacerbated the threat to aquatic life. In all, about 10 to 12 miles of the Blackfoot River mainstem exhibited

concentrations of zinc which at least periodically surpassed maximum recommended levels.

Lead concentrations in the Blackfoot River appeared to be a problem only at the uppermost monitoring station and then only during periods of elevated streamflow (Figures 19 and 20). Acute toxicity criteria for lead (not shown on figures but listed in Table 6) were never surpassed during our monitoring. Similar to the trend for copper, lead concentrations increased slightly in the middle and lower Blackfoot River during the April 8, 1989 monitoring. Again, we feel this resulted from a resuspension of metals-enriched river bottom sediments or from our having sampled a dirtier "slug" of water at downstream locations. It is unlikely that the data point to additional metals sources downstream from the headwaters.

Arsenic was sampled at all river locations only once during this study (Figure 21). During August 1988, concentrations were below the limit of analytical detection at all river locations and were well below the applicable toxicity criteria. Other measurements for arsenic made during the chronic toxicity bioassays indicated that arsenic is unlikely to present a threat to aquatic life at any location along the river, during any conditions of streamflow (Table 6).

Cadmium concentrations were measured during low and high streamflow conditions. However, a contamination problem during the initial August 1988 sampling invalidated those results. During runoff conditions, water column concentrations of cadmium surpassed the chronic toxicity criterion by more than two times in the extreme headwaters of the river. Concentrations declined rapidly in the upper 10 miles of the river to levels generally below detection.

In summary, water column concentrations of all the metals were greater during periods of elevated streamflow, and the zone of effect (miles of river in which criteria were exceeded) was extended downstream during runoff periods. Overall, it appeared that at least 10 to 12 miles of the upper Blackfoot River periodically experienced potentially damaging concentrations of metals. Zinc was the most problematic metal, followed by copper, cadmium and then lead. Zinc was the only metal that consistently surpassed aquatic life criteria and it affected up to five miles of the upper Blackfoot River on a year-round basis.

A review of the tabulated metals concentration data in Table 6 indicates that 1) metals concentrations in the Blackfoot River in 1988-1989 were generally within the ranges of concentrations reported by Spence (1975) for 1968-1973, and 2) Blackfoot River metals concentrations were highest during the first part of spring runoff (i.e. April) and lowest during summer low flow periods, indicating that nonpoint sources of metals (e.g. streamside and stream channel tailings) may be more important than mine adit discharges (e.g. Mike Horse adit discharge).

Table 6. Blackfoot River Ambient Water Quality Data Summary - Metals Monitoring Data

No.	Station Description	Date	TR Copper (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Zinc (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Arsenic (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Cadmium (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Lead (ug/l)
Mainstem Stations															
1	Blackfoot River below Meadow Creek	07-28-88	9	17	26	352	151	167	<1	190	360	---	---	---	<1
		08-02-88	7	17	26	341	149	165	<1	190	360	---	---	---	<1
		04-08-89	34	13	20	1040	116	128	---	---	---	2.8	1.2	4.4	11
		04-20-89	50	10	15	662	89	98	<1	190	360	2.2	1.0	3.1	18
		05-11-89	20	---	---	523	---	---	<1	190	360	1.8	---	---	5
	Other Data (1968)[1]														
	Range		<10			10-440			<1						<10
	Mean		<10			234			<1						<10
	N=		(7)			(7)			(7)						(1)
2	Blackfoot River at Flesher Pass Road Bridge	08-02-88	<1	15	23	23	133	147	<1	190	360	---	---	---	<1
		08-03-88*	<1	15	23	37	135	149	<1	190	360	---	---	---	<1
		04-08-89	8	12	18	322	106	117	---	---	---	0.6	1.1	3.9	2
		04-26-89*	6	10	15	208	92	102	<1	190	360	0.4	1.0	3.3	2
		05-11-89	3	---	---	188	---	---	<1	190	360	0.4	---	---	1
	Other Data (1968-1973)[1]														
	Range		<10-180			<10-940			<1						<10
	Mean		19			129			<1						<10
	N=		(12)			(12)			(2)						(3)
3	Blackfoot River at Hogum Creek Road Bridge	08-02-88	<1	15	23	4	132	145	<1	190	360	---	---	---	<1
		08-03-88*	<1	15	23	6	134	148	<1	190	360	---	---	---	<1
		02-16-89*	<1	14	22	5	127	140	---	---	---	<0.2	1.3	5.0	---
		04-08-89	4	10	15	79	92	102	---	---	---	<0.2	1.0	3.3	<1
		04-26-89	6	9	13	75	82	91	<1	190	360	0.2	0.9	2.8	2
		05-11-89	3	---	---	73	---	---	<1	190	360	0.2	---	---	<1
	Other Data (1968-1971)[1]														
	Range		<10-40			<10-30			<1						<10
	Mean		8			9			<1						<10
	N=		(12)			(12)			(4)						(2)

Table 6. Continued.

No.	Station Description	Date	TR Copper (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Zinc (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Arsenic (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Cadmium (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Lead (ug/l)
4	Blackfoot River between Landers Fork and Lincoln	08-02-88	<1	16	24	<0.5	140	155	<1	190	360	---	---	---	<1
		08-03-88*	<1	11	16	<0.5	98	108	<1	190	360	---	---	---	<1
		04-08-89	3	11	16	35	97	107	---	---	---	<0.2	1.0	3.5	<1
		04-26-89*	4	11	16	29	98	108	<1	190	360	<0.2	1.1	3.5	1
		05-11-89	4	---	---	19	---	---	1	190	360	0.2	---	---	3
	Other Data (1973)[1]														
	Range		<10-10			<10-10			<1						<10
	Mean		<10			<10			<1						<10
	N=		(2)			(2)			(2)						(2)
5	Blackfoot River at Dalton Mountain Road Bridge	08-02-88	<1	19	31	<0.5	173	191	<1	190	360	---	---	---	<1
		08-03-88*	<1	19	31	<0.5	173	191	<1	190	360	---	---	---	<1
		02-16-89*	<1	19	30	7	169	187	---	---	---	<0.2	1.8	7.3	---
		04-08-89	<1	17	26	4	151	167	---	---	---	<0.2	1.6	6.3	<1
		04-26-89*	4	13	20	13	117	129	<1	190	360	<0.2	1.2	4.5	1
	Other Data (1968-1973)[1]														
	Range		<10-30			<10-60			<1						<10
	Mean		8			13			<1						<10
	N=		(12)			(12)			(5)						(4)
6	Blackfoot River at Nevada-Ogden Road Bridge	08-02-88	<1	19	30	<0.5	169	187	<1	190	360	---	---	---	<1
		08-03-88*	<1	19	30	<0.5	170	188	<1	190	360	---	---	---	<1
		04-08-89	<1	16	24	5	139	154	---	---	---	<0.2	1.5	5.6	<1
		04-26-89	4	13	20	13	119	132	1	190	360	<0.2	1.3	4.6	1
	Other Data (1968-1973)[1]														
	Range		<10-60			<10-300			<1						<10
	Mean		13			30			<1						<10
	N=		(12)			(12)			(3)						(1)
7	Blackfoot River at Helmville Bridge	08-02-88	<1	18	28	<0.5	161	178	2	190	360	---	---	---	<1
		08-03-88*	<1	18	29	<0.5	163	180	<1	190	360	---	---	---	<1
		02-16-89*	<1	18	28	29	159	175	---	---	---	<0.2	1.6	6.7	<1
		04-08-89	3	12	18	11	110	121	---	---	---	<0.2	1.2	4.1	2
		04-26-89*	5	15	22	8	130	143	2	190	360	<0.2	1.4	5.1	2

Table 6. Continued.

No.	Station Description	Date	TR Copper (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Zinc (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Arsenic (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Cadmium (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Lead (ug/l)
8	Blackfoot River above Monture Creek	08-03-88	<1	17	26	<0.5	150	166	<1	190	360	---	---	---	<1
		08-03-88*	<1	17	26	<0.5	149	165	<1	190	360	---	---	---	<1
		04-08-89	4	12	19	14	110	122	---	---	---	<0.2	1.2	4.1	2
		04-26-89*	4	12	18	5	110	121	2	190	360	<0.2	1.2	4.1	1
9	Blackfoot River below Scotty Brown Bridge	08-03-88	<1	16	25	<0.5	143	158	<1	190	360	---	---	---	<1
		08-03-88*	<1	16	24	<0.5	139	154	<1	190	360	---	---	---	<1
		02-16-89*	<1	17	26	7	149	165	---	---	---	<0.2	1.6	6.2	---
		04-08-89	4	12	18	11	105	116	---	---	---	<0.2	1.1	3.9	2
		04-26-89*	3	8	12	7	75	82	1	190	360	<0.2	0.8	2.5	1
10	Blackfoot River at Sperry Grade	08-03-88	<1	17	26	<0.5	149	165	<1	190	360	---	---	---	<1
		08-03-88*	<1	16	25	<0.5	142	157	<1	190	360	---	---	---	<1
		04-08-89	4	12	18	11	106	117	---	---	---	0.7	1.1	3.9	2
11	Blackfoot River at Roundup Bar Bridge	08-03-88	<1	16	24	<0.5	141	156	<1	190	360	---	---	---	<1
		08-03-88*	<1	15	24	<0.5	138	153	<1	190	360	---	---	---	<1
		02-16-89*	<1	15	24	5	138	152	---	---	---	<0.2	1.4	5.5	---
		04-08-89	3	11	17	8	101	112	---	---	---	<0.2	1.1	3.7	2
		04-26-89*	2	10	15	4	91	100	<1	190	360	<0.2	1.0	3.2	<1
12	Blackfoot River at Ninemile Prairie	08-03-88	<1	16	24	<0.5	139	154	<1	190	360	---	---	---	<1
		08-03-88*	<1	15	24	<0.5	138	153	<1	190	360	---	---	---	<1
		04-08-89	4	11	17	22	102	113	---	---	---	<0.2	1.1	3.7	2
13	Blackfoot River at Johnsrud Park	08-03-88	<1	15	24	<0.5	138	153	<1	190	360	---	---	---	<1
		08-03-88*	<1	15	23	0.5	136	150	<1	190	360	---	---	---	<1
		04-08-89	3	11	16	14	99	109	---	---	---	<0.2	1.1	3.6	2

Table 6. Continued.

No.	Station Description	Date	TR Copper (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Zinc (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Arsenic (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Cadmium (ug/l)	Toxicity Criterion Chronic	Toxicity Criterion Acute	TR Lead (ug/l)
14	Blackfoot River at USGS station near Bonner	08-03-88	<1	15	23	<0.5	136	150	<1	190	360	---	---	---	<1
		08-03-88*	<1	15	23	<0.5	134	148	<1	190	360	---	---	---	<1
		04-08-89	2	10	15	6	91	100	---	---	---	0.2	1.0	3.2	1
		04-26-89*	2	10	15	3	89	98	<1	190	360	<0.2	1.0	3.1	2
	Other Data (1984-1989)[1]														
	Range		<1-<10			<0.5-20			<1-1			<0.2-1.1			<1
	Mean		<10			<5			<1			<0.2			<1
	N=		(80)			(65)			(65)			(15)			(15)
	Other Data (1968-1970)[1]														
	Range		<10-30			<10-80			<1						
	Mean		<10			14			<1						
	N=		(12)			(12)			(2)						
	Tributary Stations														
2.3	Willow Creek near mouth		1	---	---	2	---	---	<1	190	360	<0.2	---	---	<1
	Other Data (1971-1973)[1]														
	Range		<10-20			<10-10			<1-2						<10-10
	Mean		<10			<10			<1						<10
	N=		(8)			(8)			(6)						(7)

* Four-day time-composite samples collected in conjunction with chronic toxicity bioassays.

1 Sources of other data include Spence (1975), Ingman (1987, 1990) and Lambing (1988, 1989).

Figure 15.

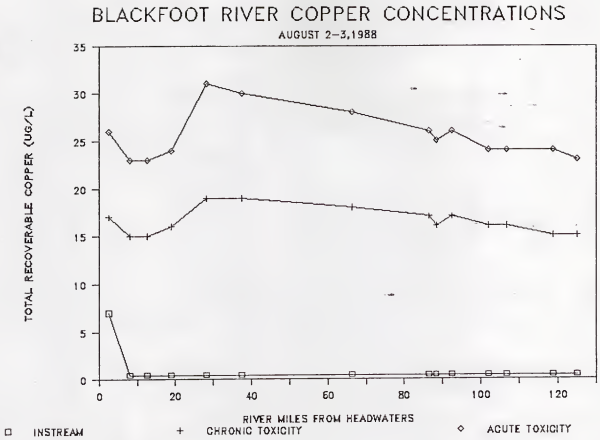


Figure 16.

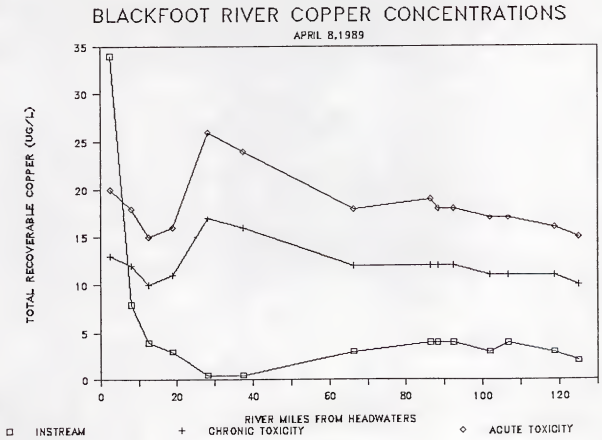


Figure 17.

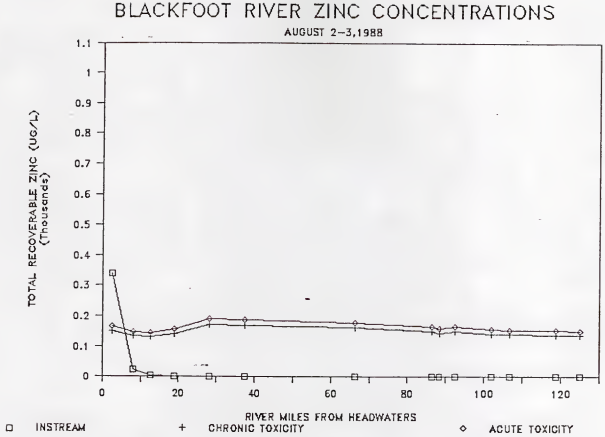


Figure 18.

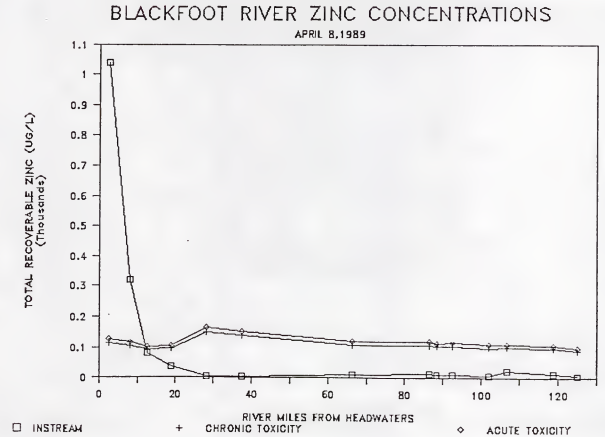


Figure 19.

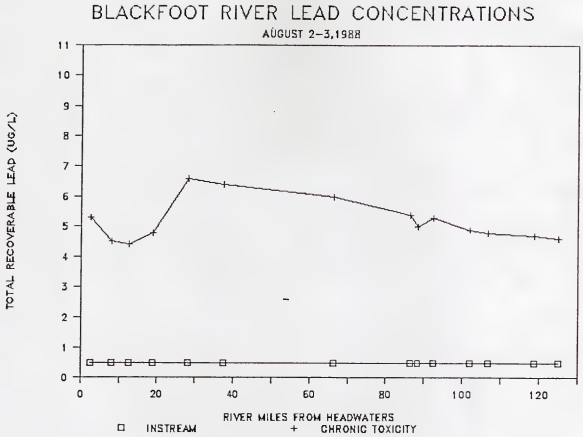


Figure 20.

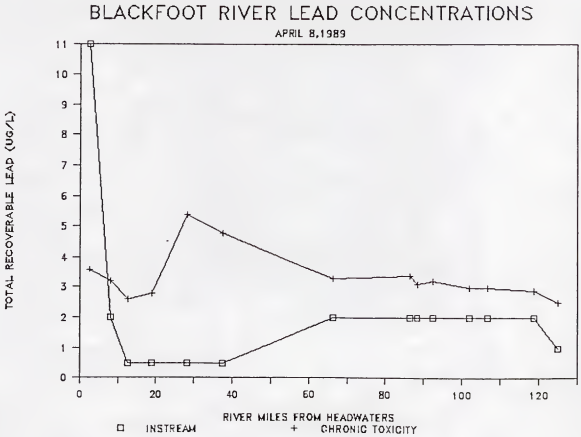


Figure 21.

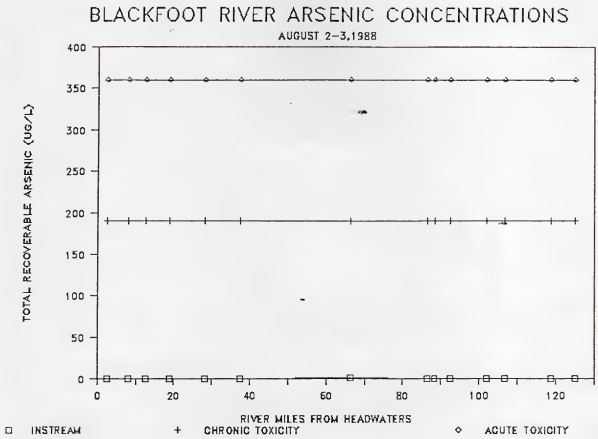
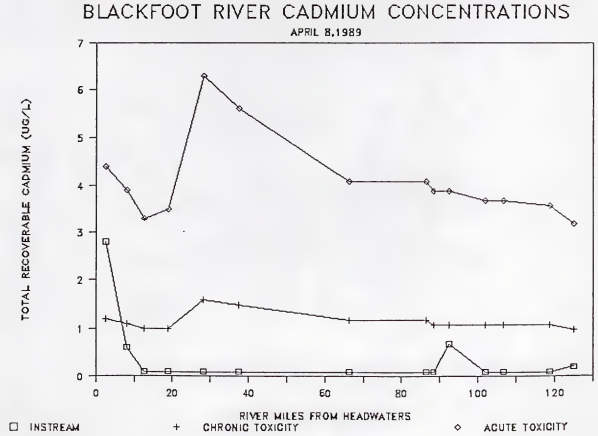


Figure 22.



5.2.4 Algal Nutrients

The amount of nitrogen and phosphorus in water often controls the amount of algae a river or lake produces. Nutrients are natural components of every aquatic ecosystem. The inherent fertility of a stream, measured in ug/l of nitrogen, phosphorus and other nutrients, is an important factor in fish production.

But too much of these nutrients, from natural or cultural sources, can produce nuisance growths of algae. In extreme cases, large concentrations of attached or suspended algae can deplete the oxygen dissolved in the water and favor the propagation of "rough" fish over game fish. The scientific term for this phenomenon is eutrophication. Of the many nutrients required by algae and other aquatic plants, nitrogen and phosphorus are the two elements usually in the shortest supply in natural waters. This means that the growth of algae is often controlled by the concentration of nitrogen or phosphorus, or both, in the water column. Only the soluble inorganic forms of these two nutrients are bioavailable, that is readily available for plant uptake. The sum of the soluble inorganic nitrogen fractions is called total soluble inorganic nitrogen, or TSIN. Soluble orthophosphate is referred to as soluble reactive phosphorus, or SRP.

The U.S. EPA recommends that TSIN concentrations should not exceed 1000 ug/l in order to prevent development of nuisance algae in streams (water quality criteria matrix in MDHES, 1986). This criterion is a general guideline which may be too high for some streams. Recent work by Watson (1989) indicated that TSIN levels below 250 ug/l limited algal standing crops in artificial streams containing Clark Fork River water.

The U.S. EPA does not establish a criterion for SRP but instead gives recommendations for total phosphorus, because it is possible for bound phosphorus to be released by bacterial and

chemical action and eventually become bioavailable. The total phosphorus criterion for prevention of plant nuisances in streams not discharging directly to lakes or impoundments is 100 ug/l (U.S. EPA, 1986). For the Clark Fork River, Watson (1989) found that concentrations of SRP below 40 and 20 ug/l limited filamentous algae and diatom (slime) algae standing crops, respectively.

The upper and middle reaches of the Clark Fork are some of the most productive stream waters in Montana west of the Continental Divide from the standpoint of nutrient concentrations and the potential to grow algae (Bahls et al. 1979a, 1979b). However, beneficial water uses have suffered (Johnson and Schmidt, 1988; Ingman, 1990), and efforts are currently underway to control sources of nutrient inputs to the basin. The nutrients originate primarily from municipal and industrial wastewater discharge and nonpoint sources (e.g. agricultural and silvicultural runoff).

The Blackfoot River would generally be thought of as free from the threat of nutrient-related impacts due to limited human populations and development activities in the basin. However, to our knowledge, nutrient concentrations have not been systematically examined throughout the river basin. Also, certain reaches of the river are known to support abundant growths of nuisance filamentous algae, notably in the area of the Helmville Bridge (monitoring station 7).

Concentrations of nutrients in the Blackfoot River and its tributaries are listed in Table 7. Also included are summaries of the limited historical data. Figures 23-26 are graphs of measured nutrient concentrations in the Blackfoot River and in tributaries. Figures 27 and 28 show average concentrations of nutrients in the Blackfoot River near its mouth as compared to those for other Clark Fork Basin streams and for well known rivers east of the Continental Divide.

Concentrations of bioavailable phosphorus and nitrogen in the Blackfoot were small during the low streamflows of August 1988, and well below criteria values for the prevention of nuisance levels of algae (Figures 23 and 24). During the high flows of April, 1989, nutrient concentrations were much higher. Bioavailable phosphorus concentrations increased markedly downstream of the Nevada Creek confluence. While concentrations declined somewhat with increasing distance below Nevada Creek, measured phosphorus values exceeded the algae criteria at all downstream monitoring locations. The trend for bioavailable nitrogen concentrations during the runoff period was more erratic and no distinct trend was apparent. While the applicable criteria for the prevention of nuisance algae were never exceeded, many of the values can be considered as high. Many nitrate-nitrogen analyses conducted by the MDHES chemistry laboratory during April 1989 were similarly high and a contamination problem originating in the lab is suspected, even though routine quality assurance procedures failed to detect a problem. Nitrate-nitrogen is one of the components used to compute the TSIN concentration. Thus, the April 1989 TSIN data are somewhat suspect. Of significance were unnaturally high concentrations of ammonia-nitrogen at all monitoring locations downstream of Nevada Creek. Ammonia originates primarily from animals wastes and is rapidly oxidized to nitrate-nitrogen in streams with adequate levels of dissolved oxygen. It is highly toxic to aquatic life in sufficient concentrations but the measured values were well within safe levels. The presence of ammonia donwstream of Nevada Creek points to the presence of agricultural runoff in the river during this rapid snowmelt event. It is likely that the Nevada Creek drainage was only one of several sources. Ammonia was not detected in the upper Blackfoot River.

These nutrient data do not allow us to ascertain how frequently or for how long phosphorus concentrations are elevated in the Blackfoot River. Concentrations of nutrients which are elevated only during runoff probably do not pose a problem because

levels of turbidity limit light penetration and preclude algal growth. However, the presence of elevated phosphorus concentrations downstream of Nevada Creek in a reach that exhibits rather heavy growths of filamentous algae suggests a possible relationship. It is likely that nutrient concentrations in this reach are elevated at other time of the year as well.

From these data, it is apparent that nutrient concentrations in the Blackfoot drainage are generally low but seasonally are elevated. The primary sources implied are nonpoint source inputs originating from various land use activities.

The nutrient survey of Blackfoot River tributaries documented concentrations of total phosphorus and total nitrogen in various tributary drainages during the peak runoff period of 1989 (Figures 25 and 26). Landers Fork, Nevada Creek, the North Fork, and Elk and Union creeks contained elevated phosphorus concentrations relative to other tributaries. However, only Nevada Creek exceeded the total phosphorus criterion of 100 ug/l by a substantial margin. Each of these tributaries carried substantial TSS concentrations when sampled. Since phosphorus is readily adsorbed to sediment particles, the sediment was the presumed source of measured phosphorus concentrations.

Landers Fork, East Fork Chamberlain Creek, and Elk Creek contained somewhat elevated nitrogen concentrations when compared to the other tributaries, possibly pointing to moderate nonpoint source pollution problems. Nitrogen concentrations in Nevada Creek, however, were very elevated when compared to the 13 other tributaries. It is reasonable to assume that the nutrient contributions from the Nevada Creek watershed resulted from the intensive land and water use practices. The elevated nutrients suggest agricultural runoff enriched with fertilizer, soil particles and animal wastes.

As we have said, nutrients can be deleterious when present in substantial concentrations, but they also determine, in part, a river's ability to grow plants, insects and fish. From the standpoint of maintaining a productive fishery, a moderate amount of phosphorus and nitrogen is desirable. The Blackfoot River is less rich in nutrients, especially bioavailable phosphorus (SRP), than other west slope streams (Figure 27). By comparison to popular east slope streams, it would be considered relatively nutrient poor (Figure 28). While the authors are not advocating nutrient additions to stimulate production in the Blackfoot River, the existing nutrient limitation is a fact that needs to be considered in the management of the river's fishery. A fact to remember is that pristine waters are generally nutrient poor while the most productive fishing streams usually are not as esthetically pleasing as those which are less fertile. Culturally-induced nutrient enrichment of streams increases growth of algae, decreases water clarity, and reduces esthetic enjoyment and recreational appeal.

Table 7. Blackfoot River Ambient Water Quality Data Summary - Nutrients Monitoring Data

No.	Station Description	Date	D-PO_4 [1] (ug/l)	Total P (ug/l)	NO_3+NO_2-N [1] (ug/l)	NH_3+NH_4-N [1] (ug/l)	KJL-N (ug/l)	TSIN [2] (ug/l)	Total N [3] (ug/l)
Mainstem Stations									
1	Blackfoot River below Meadow Creek	08-02-88	<1	---	90	<10	---	95	---
		04-08-89	<1	20	190	<10	300	195	490
		05-11-89	2	24	10	<10	500	15	510
2	Blackfoot River at Flesher Pass Road Bridge	08-02-88	1	---	20	<10	---	25	---
		04-08-89	1	30	60	<10	400	65	460
		05-11-89	2	18	10	<10	500	15	510
	Other Data (1968-1973) [4]								
	Range		<10-10	<10-30	10-80	<10	<10-390		
	Mean		<10	11	30	<10	233		
	N=		(6)	(7)	(6)	(6)	(6)		
3	Blackfoot River at Hogum Creek Road Bridge	08-02-88	3	---	<10	<10	---	10	---
		04-08-89	6	47	220	<10	500	225	720
		05-11-89	10	39	10	<10	500	15	510
				influence of L.FK					
4	Blackfoot River between Landers Fork and Lincoln	08-02-88	1	---	30	<10	---	35	---
		04-08-89	9	51	190	<10	400	195	590
		05-11-89	63	94	20	<10	500	25	520
5	Blackfoot River at Dalton Mountain Road Bridge	08-02-88	1	---	10	<10	---	15	---
		04-08-89	10	38	70	<10	400	75	470
		05-11-89	73	112	20	<10	400	25	420
	Other Data (1968-1973) [4]								
	Range		<10-30	<10-170	10-160	<10	180-850		
	Mean		11	36	60	<10	440		
	N=		(7)	(7)	(8)	(7)	(7)		
6	Blackfoot River at Nevada-Ogden Road Bridge	08-02-88	1	---	20	<10	---	25	---
		04-08-89	20	55	170	<10	500	175	670
		05-11-89	81	132	10	<10	400	15	410
	Other Data (1968-1973) [4]								
	Range		<10-40	<10-190	10-600	<10	200-750		
	Mean		10	43	170	<10	380		
	N=		(6)	(7)	(7)	(7)	(7)		

Table 7. Continued.

No.	Station Description	Date	O-PO_4 [1] (ug/l)	Total P (ug/l)	NO_3+NO_2-N [1] (ug/l)	NH_3+NH_4-N [1] (ug/l)	KJL-N (ug/l)	TSIN [2] (ug/l)	Total N [3] (ug/l)
6.5	Blackfoot River at HW 271 Bridge	05-11-89	96	150	10	<10	700	15	710
7	Blackfoot River at Helmville Bridge	08-02-88	1	---	20	<10	---	25	---
		04-08-89	140	343	110	60	1000	170	1110
		05-11-89	119	171	20	20	800	40	820
8	Blackfoot River above Monture Creek	08-03-88	2	---	60	<10	---	65	---
		04-08-89	147	408	140	70	1500	210	1640
		05-11-89	109	159	40	<10	500	45	540
9	Blackfoot River below Scotty Brown Bridge	08-03-88	1	---	50	<10	---	55	---
		04-08-89	107	353	160	60	1200	220	1360
		05-11-89	90	135	40	<10	700	45	740
10	Blackfoot River at Sperry Grade	08-03-88	2	---	20	<10	---	25	---
		04-08-89	94	342	170	50	1200	220	1370
		05-11-89	89	131	40	20	1300	60	1340
11	Blackfoot River at Roundup Bar Bridge	08-03-88	1	---	20	<10	---	25	---
		04-08-89	67	282	140	50	1200	190	1340
		05-12-89	63	97	30	<10	600	35	630
12	Blackfoot River at Ninemile Prairie	08-03-88	1	---	30	<10	---	35	---
		04-08-89	74	265	140	50	1100	190	1240
13	Blackfoot River at Johnsrud Park	08-03-88	1	---	30	<10	---	35	---
		04-08-89	81	286	160	40	1100	200	1260
		05-12-89	78	111	<10	<10	600	10	600
14	Blackfoot River at USGS station near Bonner	08-03-88	2	---	30	<10	---	35	---
		04-08-89	60	211	190	30	900	220	1090
		05-12-89	64	103	20	<10	400	25	420
	Other Data (1984-1989) [4]								
	Range		<1-68	2-100	<10-90	<10-30	<100-900	<10-80	---
	Mean		7	18	18	<10	187	21	---
	N=		(80)	(80)	(80)	(65)	(80)	(65)	---

Table 7. Continued.

No.	Station Description	Date	O-PO_4 [1] (ug/l)	Total P (ug/l)	NO_3+NO_2-N [1] (ug/l)	NH_3+NH_4-N [1] (ug/l)	KJL-N (ug/l)	TSIN [2] (ug/l)	Total N [3] (ug/l)
Tributary Stations									
2.7	Alice Creek near mouth	05-11-89	6	37	30	<10	400	35	430
3.5	Landers Fork near mouth	05-11-89	73	105	20	<10	600	25	620
6.3	Arrastra Creek near mouth	05-11-89	12	45	60	<10	400	65	460
6.7	Nevada Creek near mouth.	05-11-89	155	234	10	10	1200	20	1210
7.5	North Fork Blackfoot River near mouth	05-11-89	82	120	60	<10	400	65	460
8.3	Monture Creek near mouth	05-11-89	41	76	20	<10	500	25	520
8.7	East Fork Chamberlain Creek near mouth	05-11-89	24	57	20	<10	700	25	720
9.5	Cottonwood Creek near mouth	05-12-89	19	48	40	20	500	60	540
10.3	Clearwater River near mouth	05-12-89	5	27	20	<10	200	25	220
10.7	Blanchard Creek near mouth	05-12-89	20	45	<10	<10	500	10	500
11.5	Elk Creek near mouth	05-12-89	65	95	<10	<10	600	10	600
12.5	Belmont Creek near mouth	05-12-89	9	27	10	<10	400	15	410
13.3	Gold Creek near mouth	05-12-89	11	34	<10	<10	200	10	200
13.7	Union Creek near mouth	05-12-89	79	115	40	20	500	60	540

1 Analyses for O-PO_4, NO_3+NO_2-N and NH_3+NH_4-N were performed on filtered (0.45 um) samples in August 1988 and April 1989 and results are expressed as dissolved concentrations. Analyses for those parameters were made on unfiltered samples in May 1989 and results are as total concentrations.

2 Total soluble inorganic nitrogen (TSIN) was computed by summing concentrations of NO_3+NO_2-N and NH_3+NH_4-N.

3 Total nitrogen (Total N) was computed by summing concentratons of NO_3+NO_2-N and KJL-N.

4 Sources of other data include Spence (1975), Ingman (1987, 1990) and Lambing (1988, 1989).

Figure 23.

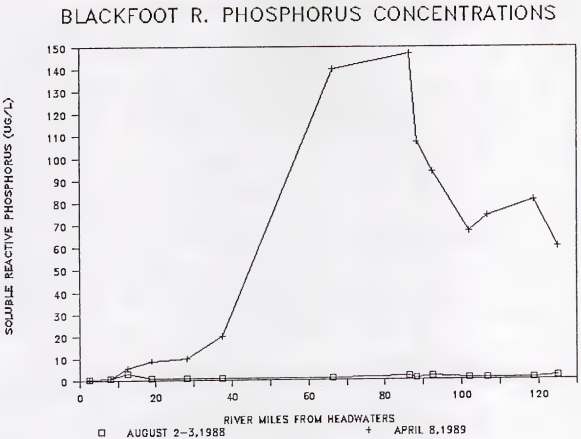


Figure 24.

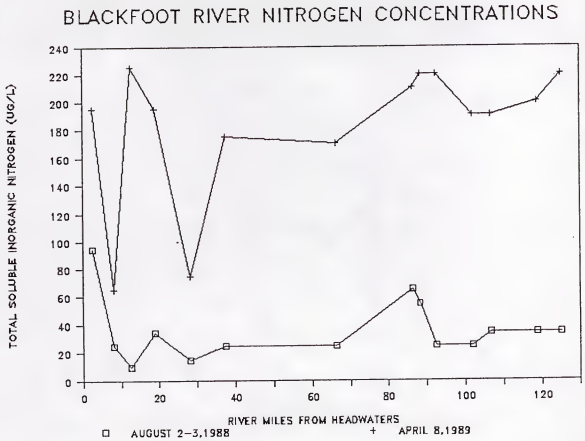
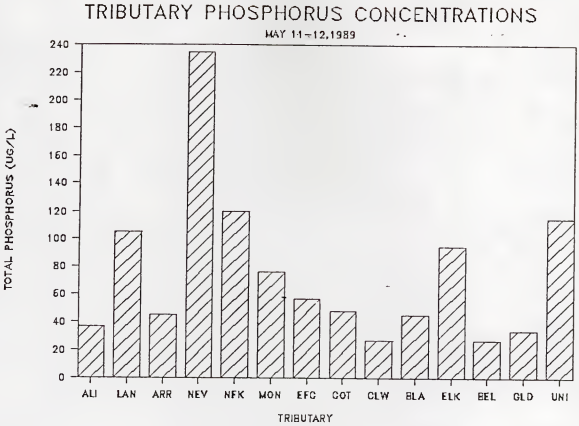


Figure 25.



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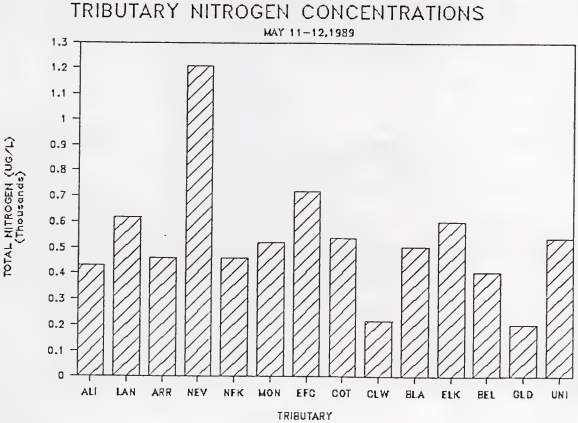

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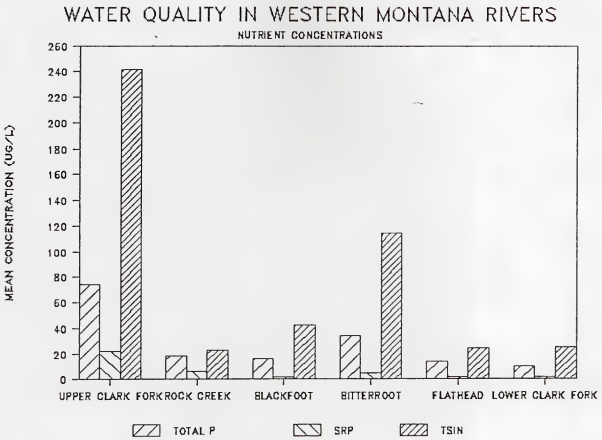

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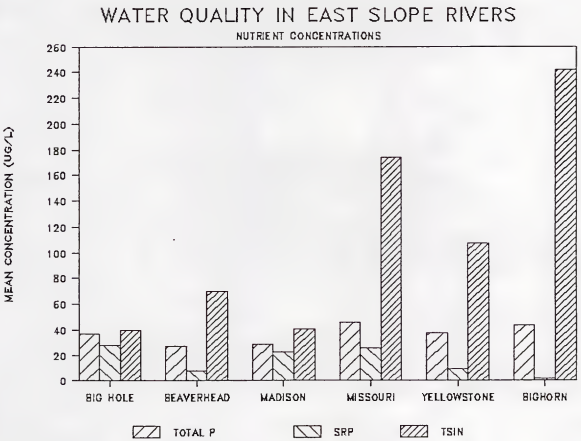


5.3 Chronic Toxicity Bioassays

The summer low flow bioassay tested 14 stations from the headwaters to the mouth, and used the North Fork as the control. In the summer low flow bioassay, there was 100 percent mortality at station 1, which indicated that acutely toxic conditions existed. Mortality of 10 to 30 percent occurred in the middle reach (stations 6-10) and further downstream at station 13. Also indicative of toxicity was the poor reproduction in almost all waters which were tested. The best reproduction occurred in the controls. Reproduction in mainstem waters steadily declined downstream from Flesher Pass Road (17.8 average) to the Helmville Bridge (4.8 average) and then averaged between approximately 6 and 11 (Table 8). The toxicity in the headwaters area (station 1) can be explained by the concen- trations zinc (Table 6) which exceeded criteria. The sources of the metals are likely mine and tailings drainage from the Mike Horse Mine area and the Carbonate Mine along Highway 200.

The cause of the poor reproduction in waters collected further downstream is unknown. None of the potential toxicants tested for (heavy metals and other priority pollutants) were detected in concentrations high enough to exceed EPA criteria for the protection of aquatic life. Another consideration must be whether the poor reproduction was really an acclimation response to mainstem water which was of different quality than the control water, though not necessarily toxic. Other possible explanations include an inadequate food preparation, unexplained contamination, or a toxicant which was not identified.

The second bioassay was conducted during winter low flow to see whether results of the first bioassay could be confirmed. Fewer sites were tested, and the control was moved to a mainstem station (Blackfoot River at Hogum Creek). In addition, several test waters were spiked with 0.2 mg/l and 2.0

mg/l EDTA, a metals complexing agent which would remove metal toxicity if it was present.

Mortality of 20 percent occurred in water from stations 5 and 7, but reproduction in surviving adults and in other test waters which had not been spiked with EDTA appeared normal (Table 9). In fact, average reproduction was significantly higher in three of the four mainstem stations downstream of the control. The addition of EDTA to three test waters did not improve reproduction or survival, which would indicate that metals were not in concentrations high enough to cause mortality or inhibit reproduction. The mortality which occurred in waters from Stations 5 and 7 appears to be real, as similar mortality occurred in the EDTA spikes. Metals which were analyzed were either undetectable or in very low concentrations (Table 6), and were not likely toxic. Again, an unidentified toxicant could have been present, or other factors (contamination, EDTA toxicity, coincidence) may be responsible.

The third bioassay, which was conducted during spring runoff, included most of the 14 stations tested in the summer low flow bioassay. The North Fork was the control. Metals-related toxicity was present at stations 1 and 2. Mortality was 100 percent and 60 percent, respectively, and reproduction in surviving adults was significantly lower than in the controls. Survival and reproduction at all other sites was unimpaired. Average reproduction was much better than in the first two bioassays. This may be explained by the availability of a better natural food base of algae and bacteria associated with runoff.

Although some contradictions were apparent in the results of these bioassays, and results could not be fully explained, some common threads are also evident. Of most significance, there is a reach of toxicity in the upper river attributable to heavy metals originating from the Mike Horse Mine area and/or the Carbonate Mine discharge along Highway 200. The extent of toxicity is flow-

dependent. During low flow conditions, toxicity was detected only at the upper-most station below Meadow Creek. During runoff, toxicity was detected at Flesher Pass Road. Water quality data (Table 6) indicate that concentrations of copper, zinc, cadmium and lead were significantly increased during high streamflow events and the toxicity criteria were exceeded further downstream.

During low flow conditions, a reach of the river from station 05 (Dalton Mountain Road Bridge) to station 11 (Roundup Bar Bridge) exhibited subtle toxicity in varying degrees mortality (10-30%). Because reproduction in surviving test organisms appeared normal during one low flow bioassay, and because analyses for potentially toxic constituents (metals and priority pollutants) did not detect concentrations which would be of concern, it is impossible to state conclusively that the toxicity was real. Several explanations which would have to be considered are that the mortality was not related to toxicity, but to some flaw in the test design or methodology, or to some toxicant which was present but not detected.

Table 8. Summary of Blackfoot River Summer Low Flow Bioassay (July 29-August 5, 1988)

No.	Station Location	Percent Mortality	Total Reproduction	7-Day[1] Average Reproduction	95% Confidence Interval	Sites Significantly Different From
	Control #1 North Fork	0	206	20.6	16.8-24.4	1, 5 - 10, 12 - 14
	Control #2 North Fork	0	193	19.3	17.3-21.3	1, 5 - 10, 12 - 14
1	Blackfoot River below Meadow Creek	100	0	0	0	All
2	Blackfoot River at Flesher Pass Road Bridge	0	178	17.8	14.0-21.6	6, 7, 10
3	Blackfoot River at Hogum Creek Road Bridge	0	163	16.3	13.7-18.9	6, 7, 10
4	Blackfoot River between Landers Fork and Lincoln	0	136	13.6	7.6-19.6	None
5	Blackfoot River at Dalton Mountain Road Bridge	0	105	10.5	6.3-14.7	Control 1, Control 2
6	Blackfoot River at Nevada-Ogden Road Bridge	10	77	8.4	5.2-11.6	Control 1, Control 2
7	Blackfoot River at Helmville Bridge	20	38	4.8	1.5-8.1	Control 1, Control 2, 2, 3
8	Blackfoot River at Monture Creek	10	84	9.3	5.6-13.0	Control 1, Control 2
9	Blackfoot River below Scotty Brown Bridge	30	43	6.2	0.3-12.0	Control 1, Control 2
10	Blackfoot River at Sperry Grade fishing access site	10	73	8.0	4.3-11.6	Control 1, Control 2, 2, 3

Table 8. Continued.

No.	Station Location	Percent Mortality	Total Reproduction	7-Day[1] Average Reproduction	95% Confidence Interval	Sites Significantly Different From
11	Blackfoot River at Roundup Bar Bridge	0	112	11.2	6.5-15.9	None
12	Blackfoot River at Ninemile Prairie	0	103	10.3	7.4-13.2	Control 1, Control 2
13	Blackfoot River at Johnsrud Park	10	79	8.8	4.9-12.6	Control 1, Control 2
14	Blackfoot River at USGS Gaging Station near Bonner	0	81	8.1	4.0-12.2	Control 1, Control 2

1 Calculated as sum of daily average reproduction per live adult.

Table 9. Summary of Blackfoot River Winter Low Flow Bioassay (February 10-17, 1989).

No.	Station Location	Percent Mortality	Total Reproduction	7-Day[1] Average Reproduction	95% Confidence Interval	Sites Significantly Different From[2]
Control	Control Blackfoot River at Hogum Creek Bridge Road	0	233	23.3	20.2-26.4	9, 11, Control B
NF	North Fork	0	213	21.3	20.1-22.5	5, 7, 9, 11
5	Blackfoot River at Dalton Mountain Road Bridge	20	312	31.2	29.2-33.2	Control, NF
7	Blackfoot River at Helmville Bridge	20	231	23.1	24.6-33.3	NF
9	Blackfoot River below Scotty Brown Bridge	0	305	30.5	29.0-32.0	Control, NF
11	Blackfoot River at Roundup Bar Bridge	0	309	30.9	28.7-33.1	Control, NF
Control A	Control + 0.2 mg/l EDTA	10	216	22.5	18.6-26.5	Control B
Control B	Control + 2.0 mg/l EDTA	0	117	11.7	9.2-14.2	Control, Control A
07A	07 + 0.2 mg/l EDTA	20	224	26.7	22.2-31.1	---
07B	07 + 2.0 mg/l EDTA	30	228	30.3	27.9-32.7	---
09A	09 + 0.2 mg/l EDTA	0	271	27.1	22.1-32.1	---
09B	09 + 2.0 mg/l EDTA	10	264	29.3	26.8-31.8	---

1 Calculated as sum of daily average reproduction per live adult.
2 Test waters spiked with EDTA were compared only to other waters of the same site.

Table 10. Summary of Blackfoot River Spring Runoff Bioassay (April 21-28, 1989).

No.	Station Location	(%) Mortality	Total Reproduction	7-Day[1] Average	95% Confidence Interval	Significantly Different From
	Control #1 North Fork	0	331	33.1	30.8-35.4	2, 6, 7, 9
	Control #2 North Fork	20[2]	296	34.8	33.1-36.4	2, 7, 9
1	Blackfoot River below Meadow Creek	100	---	---	---	All
2	Blackfoot River at Flecher Pass Road Bridge	60	172	18.0	16.7-19.4	All
3	Blackfoot River at Hogum Creek Road Bridge	0	356	35.6	33.9-37.3	2, 7, 9
4	Blackfoot River between Landers Fork and Lincoln	0	339	33.9	32.0-35.8	2, 7, 9
5	Blackfoot River at Dalton Mountain Road Bridge	0	360	36.0	34.3-37.7	2, 9
6	Blackfoot River at Nevada-Ogden Road Bridge	0	380	38.0	36.4-39.6	Control 1, 2
7	Blackfoot River at Helmville Bridge	0	399	39.9	38.1-41.7	Control 1, Control 2, 2 - 4
8	Blackfoot River at Monture Creek	0	372	37.2	35.9-38.5	2
9	Blackfoot River below Scotty Brown Bridge	0	406	40.6	38.7-42.5	Control 1, Control 2, 2 - 5
11	Blackfoot River at Roundup Bar Bridge	0	364	36.4	34.6-38.2	2
14	Blackfoot River at USGS Gaging Station near Bonner	0	365	36.5	34.5-38.5	2

1 Calculated as sum of daily average reproduction per live adult.
2 Includes one organism unintentionally destroyed during handling.

5.4 Macroinvertebrate Community Structure

The Blackfoot River supported a dynamic benthic community which included many macroinvertebrate species. Insects predominated in terms of both number of individuals and number of taxa, comprising at least 98 percent of the macroinvertebrate fauna at each site. Of the 130 taxa identified in the August samples, 120 were insects (Appendix A). Dipterans accounted for 47 taxa, including 30 genera of midges. The Blackfoot River was rich in caddisfly species and 31 taxa were identified from the samples. Mayflies, stoneflies and beetles were also well represented with 17, 13 and 8 taxa, respectively. Single species of dragonflies, moths (aquatic catepillars) and water boatmen were found. The raw data, values of indices used to characterize macroinvertebrate collections, and descriptive statistics are presented in Appendix B.

Community similarity

The Percent Community Similarity (PCS) coefficient (Appendix C) provided a quantitative comparison of faunal composition for each possible station pairing. PCS values ranged from 86 percent (stations 4 versus 5) to less than 10 percent (station 1 versus most others). A single-linkage cluster analysis (Figure 29) provided a graphic summary of these data. The benthic fauna was quite homogeneous in the Blackfoot River downstream from its confluence with the North Fork. Stations 8 through 14 (the lower river) formed a distinct cluster of stations which were similar at the 67 percent level. In contrast, only stations 4 and 5 were grouped among upper river stations. The dissimilar faunas at stations 1 through 7 indicated significant habitat and/or water quality differences in the upper Blackfoot River.

Quantitative characterizations of the insect fauna revealed few differences among stations in the lower river while numerous

differences were indicated among upstream stations (Table 11). Statistical analyses of these data are presented in Appendix D. The rationale for, and an interpretation of each index are as follows.

Macroinvertebrate density

Density estimates, although imprecise, can be a useful indicator of overall environmental condition. Densities, both for individual species and the community as a whole, exhibit an annual cycle based on life histories, food supply and stream discharge. In most streams, floods and scouring are major factors influencing macroinvertebrate density and in large temperate rivers, maxima usually occur during the late summer and autumn (Hynes, 1970). Organic enrichment can increase macroinvertebrate density above background levels and the magnitude of the increase can be used to gauge the significance of the pollution. Nutrient enrichment usually has a similar, but more diffuse impact. Total density may be reduced by other factors, including toxic pollutants, sediment deposition and unstable substrates.

The Blackfoot River supported a surprisingly large number of insects during August, 1988. For all stations combined, total macroinvertebrate density averaged nearly 2,000 macroinvertebrates per square foot sample (22,000 per square meter). Density estimates ranged from approximately 240 to 5,000 organisms per sample (2,500 to 55,000 per square meter). The highest density was at station 4 while the lowest densities were at stations 1 and 6, respectively (Figure 30). Densities at stations 9 and 7 were also relatively high, exceeding 3,000 organisms per sample. Among stations in the upper river, the number of organisms collected at station 4 was significantly higher ($P=0.05$) than at stations 1 and 6. Although densities ranged from approximately 1,000 to 3,500 organisms per sample among stations in the lower river, they were not statistically different. At most stations, estimated densities

were between 1,000 and 2,000 macroinvertebrates per sample (10,000 to 20,000 per square meter) and were similar to densities in several other Montana rivers (Table 11).

Taxa richness

The number of macroinvertebrate species, or taxa richness, is probably the best single indicator of environmental health in the Blackfoot River. It is a robust measure of biological integrity since the loss of the most sensitive taxa to any stress will affect taxa richness. Obviously, reliable comparisons require consistent taxonomy. For comparisons between studies (Table 11), it is often advantageous to use the number of mayfly, stonefly and caddisfly taxa (EPT richness) because the taxonomy of these groups tends to be relatively uniform.

With the exception of station 1, taxa richness was similar throughout the Blackfoot River. Values in the 30's and 40's indicated good to excellent water quality at stations 2 through 14. Taxa richness (Figure 31) and EPT richness (Figure 32) were significantly lower at station 1 than at all other stations.

Shannon diversity

Shannon diversity is a widely used index of environmental condition. It was originally developed as a measure of organic pollution but does respond to other forms of environmental stress. Values above three are considered indicative of good water quality while values less than two indicate polluted conditions (Weber 1973). With this broad empirical scale Shannon diversity is not a reliable indicator of slight or moderate perturbations.

Low Shannon diversity values clearly indicated environmental stress at three stations in the upper river (Figure 33). Mean values were less than 2.0 at stations 1, 4 and 5. Among all other stations, diversity values ranged from 3.1 to 3.9.

Biotic index

The biotic index was developed to detect organic pollution and is based on the indicator organism approach to water quality assessment. The tolerance values assigned to some Montana taxa remain speculative (e.g. Hydropsyche occidentalis, H. cockerelli and H. tana?) and use of this index for the Blackfoot River is experimental. The index is on a scale of 0 to 10 with higher values indicating more polluted conditions. Hilsenhoff (1987) used seven categories of water quality ranging from excellent (<3.5), very good (3.6 to 4.5), good (4.6 to 5.5), fair (5.6 to 6.5), fairly poor (6.6 to 7.5), poor (7.6 to 8.5), to very poor (>8.5).

The composite biotic index for the Blackfoot River during August, 1988 indicated very good water quality (mean = 4.4). Values were lowest at stations 1 and 6 (Figure 34), a strong indication that organic pollution was not present at these sites. An increase in organic loading was indicated at station 4 (biotic index 5.5) and was attributed to organic matter (seston) originating from the numerous side channels and beaver ponds in this stream reach.

Percent relative abundance (PRA) of the numerically dominant taxon

The relative abundance of the numerically dominant taxon was used as a simple measure of equitability. The conceptual basis for the index is that stressed environments will have communities dominated by a few taxa. The empirical scale used to evaluate these data is slightly less rigorous than that developed by the U.S.EPA (Plafkin et al. 1988). For this evaluation, PRAs less than 30 percent indicated an unstressed community while abundances from 30 to 40 percent, 40 to 50 percent and greater than 50 percent, respectively, indicated slight, moderate and severe environmental stress.

Using these criteria, environmental stress was indicated at half of the sites investigated (Figure 35). The most numerous taxon at stations 1, 4 and 5, respectively, comprised from 77 to 65 percent of the fauna. These data were significantly higher than relative abundances at all other stations. Severe environmental stress was indicated at these three stations. Although not statistically significant, slight or moderate stress was indicated at stations 6 and 7 and slight environmental stress may have been present at stations 3 and 9.

Percent relative abundance of filter-feeders

The relative abundance of various functional feeding groups (filterers, scrapers, shredders, etc.) can provide useful insights into energy transfer, organic loading and toxic conditions. The importance of each functional group varies with season. During the summer, filterers are a major component (20 to 50%) of the benthic fauna in most large rivers. Relative abundances greater than about 50 percent indicate high seston levels which are usually associated with organic/nutrient enrichment or lake outflows.

For all stations combined, the mean relative abundance of filter feeding macroinvertebrates was 37 percent. They comprised approximately 30 to 50 percent of the fauna in the lower half of the river (Figure 36). Filterers were significantly more abundant at stations 4, 5 and 7, where they comprised 60 to 70 percent of the organisms, than at all other stations. Filter-feeders were virtually absent from station 1 and comprised less than 10 percent of the fauna at station 6.

Ordinal relative abundance

A single number summary of these data were provided by the EPT to Chironomidae (midge) ratio. In general, ratios less than one

can be considered indicative of environmental stress. For the August, 1988 data, EPT to Chironomidae ratios ranged over an order of magnitude, from 1.2 (station 3) to 13.8 (station 5). The EPT to Chironomidae ratio was significantly higher at station 5 (Dalton Mountain Road Bridge) than at stations 2, 3 and 4.

Although the EPT/C was useful for statistical and preliminary analyses, much information was lost by this simplification. A graphic evaluation provided a more discriminating view of changes in ordinal relative abundance over the length of the Blackfoot River (Figure 37). In the lower river, the distribution of organisms among major aquatic insect orders was fairly consistent and typical of healthy river environments. Caddisflies and dipterans were the two most abundant orders at stations 8 through 14, where each accounted for approximately 20 to 50 percent of the fauna. Mayflies where the next most abundant group, comprising roughly 20 percent, while beetles and stoneflies accounted for approximately 10 and 5 percent, respectively. Variation and extremes in the relative abundance of these groups usually indicates some type of perturbation. A relatively severe impact was evident at station 1, where mayflies were absent, caddisflies scarce, and stoneflies (actually, only *Zapada cinctipes*) predominated. Ordinal composition was also skewed at stations 4 through 7, although the causative agents were different among stations.

Comparisons with 1971 and 1972

Comparisons with data from August of 1971 and 1972 (Spence, 1975), indicated that macroinvertebrate assemblages in the upper river (at least stations 1 through 6) have changed very little in the past 17 years. Ordinal relative abundance was particularly similar in August, 1972 and 1988 (Figure 38). The same pattern was evident in 1971, although mayflies were relatively more abundant at stations 4 and 5. Stream discharge was considerable greater in

1971 than during either 1972 or 1988 and may have been an influencing factor. Total macroinvertebrate density (Figure 39) and EPT richness (Figure 40) were also generally comparable between studies.

Synopsis of the benthic fauna and environmental conditions

Blackfoot River below Meadow Creek (station 1)

The aquatic environment at the upper-most station was severely degraded and conditions toxic to most aquatic insects were indicated. With the exception of the biotic index, which is primarily a measure of organic pollution, an impact was indicated by each quantitative assessment. The impoverished insect fauna was clear evidence of continued heavy metal pollution in the headwaters. Iron hydroxide deposits smothered substrates and further reduced the biological integrity at this site. The insect fauna in 1988 was virtually identical to that present in the early 1970s (Spence 1975) which suggests that no significant change in water quality has occurred during this period. The nemourid stonefly, Zapada cinctipes, was the only abundant insect during both surveys.

Blackfoot River at Flesher Pass Road Bridge (station 2)

Although the more subtle effects of heavy metal pollution remained at station 2, the aquatic environment at this site was much healthier than at station 1. The benthic community was diverse, with the five most numerous taxa (Hydropsyche probably H. tana, Zapada cinctipes, Tvetenia sp. and Baetis tricaudatus) representing five different insect orders. The increase in the number of taxa collected between stations 1 and 2 (20 to 48, respectively) was evidence of the reduced severity of metals-related impacts. As noted by Spence (1975), the overall environmental condition of this stream reach appeared good.

Periodic or low-level, chronic metals-related stress was indicated by the skewed composition of the insect fauna. In particular, the conspicuous absence of mayflies (aside from Baetis tricaudatus) and the relatively high percentage of metal-tolerant midges (Tvetenia sp., Cricotopus spp., Diamesa sp., Rheocricotopus sp.) were signs of metal-related impacts.

Blackfoot River at Hogum Creek Road Bridge (station 3)

The integrity of the benthic fauna was good at this site and the only impact detected was caused by an extensive algal growth. Nostoc, a bluegreen algae, was an important but temporary factor influencing the aquatic community. Near the Hogum Creek bridge, riffle substrates were covered with Nostoc colonies. The algae was heavily infested by midge larvae (Cricotopus s.g. Nostococladius which were the most abundant insect at this site. Faunal composition was quite different at station 3 compared with other stations. In addition to C. Nostococladius, caddisflies (Hydropsyche sp. and Micrasema sp.), beetles (Optioservus spp.) a mayfly (B. tricaudatus) and a stonefly (Chloroperlinae) were prominent members of the fauna.

Blackfoot River above and below Lincoln (stations 4 and 5)

Good water and habitat quality were indicated at these stations. Organic enrichment, probably originating in beaver ponds, sloughs and side channels, had a dramatic influence on the aquatic community by augmenting the food supply. Station 4 supported the highest macroinvertebrate densities encountered during this study. About 75 percent of the aquatic insects in this reach were blackflies (Simulium s.g. Eusimulium). Several of the indices used in this study detected this impact. The importance of suspended organics in this river reach is undoubtedly seasonal.

Blackfoot River at Nevada-Ogden Road Bridge (station 6)

The benthic community here was markedly different from upstream locations. The heptageniid mayfly, Rhithrogena sp., was the most abundant of 51 taxa collected at this site. The midge, Micropsectra sp., and chloroperlid stoneflies were the next most abundant insects. The abundance of these three taxa, along with the presence of numerous other taxa, indicated the absence of water quality problems at this site. The relatively low density of aquatic macroinvertebrates and the high relative abundance of Rhithrogena sp. were apparent responses to the prevalence of small stream bottom materials. The benthic community was slightly to moderately impaired by sediment deposition and generally poor habitat in this reach of the Blackfoot River.

Blackfoot River at Helmville Bridge (station 7)

The habitat and fauna at this site were unique among Blackfoot River stations and appeared to be influenced by several interrelated factors. The tremendous surface area provided by abundant aquatic vegetation had a major influence on the number and type of aquatic insects at this site. The low stream gradient, riffle substrates packed with coarse sand, luxuriant growths of aquatic vegetation, and relatively high water temperature (Peters and Spoon 1989) were important features of this aquatic environment. The interactions between physical, chemical and biological processes in this river reach are poorly understood and the significance attributed to any single feature must be speculative.

The extended drought (1985 to 1988) may have been the catalyst for shifts in the biological community at this site. Organisms adapted to cool temperatures (e.g. many stoneflies and salmonids) may have been stressed by the relatively warm water temperatures during the summer. In addition, the channel morphology and small

substrates in this river reach appeared to favor aquatic plants. Consequently, a relatively minor increase in the nutrient load, especially during periods of low stream flow and high water temperature, could produce the extensive growths of filamentous algae (Cladophora sp.) present during the summer of 1988. Higher streamflows would be expected to retard this condition.

Both the fauna and the habitat at this station were similar to those in sections of the upper Clark Fork River. The dominant taxa during August were Hydropsyche occidentalis and Simulium (s.g. Psilozia), both of which are filter-feeders. Neither species was abundant at other Blackfoot River stations but both were plentiful in the Clark Fork River upstream from Milltown Dam (McGuire, 1987). Other taxa found in the upper Clark Fork River, such as Isogenoides sp. and Psuedocloeon sp., were also found at this site on the Blackfoot River. In the Clark Fork River, these taxa were associated with relatively high water temperatures and elevated nutrient levels. Similar conditions were indicated in this reach of the Blackfoot River.

Blackfoot River downstream of the North Fork (stations 8-14)

The aquatic community was healthy in the middle and lower Blackfoot River and exhibited no indication of significant water quality or habitat degradation. The structure of the benthic community was roughly comparable to that in the Bitterroot and Missouri rivers (Table 12). The species rich, diverse insect assemblage included many pollution sensitive species.

Composition of fauna was consistent among stations. Baetis tricaudatus, Hydropsyche sp. (prob. H. tana), Simulium (Eusimulium) spp., and Micropsectra sp. were numerically dominant at each station in the lower river. Large insects including salmonflies, (Pteronarcys californica), three species of perlid stoneflies and five hydropsychid caddisflies were common throughout the lower

river. Based on 28 samples from seven different riffles, salmonfly density in riffles habitats of the lower Blackfoot River exceeded 200 per square meter during August, 1988. They appeared most abundant from the Roundup Bar Bridge downstream to Johnsrud Park.

Table 11. Mean values of selected indices characterizing macroinvertebrate assemblages in the Blackfoot River during August, 1988 (four 1.0 square foot samples at each station).

Station	density 1sq ft	taxa richness	Shannon diversity	biotic index	EPT richness	%RA dominant	%RA filterers
1	238	12	1.32	1.46	5	77	1
2	1869	35	3.71	4.03	15	22	23
3	2016	39	3.53	4.59	19	31	11
4	5154	33	1.73	5.47	18	70	71
5	2087	32	1.97	4.94	17	65	69
6	653	33	3.13	2.43	19	40	8
7	3049	36	3.22	5.02	19	40	63
8	1823	37	3.63	4.81	19	26	29
9	3585	34	3.08	5.07	17	33	43
10	2001	34	3.56	4.87	19	29	41
11	1617	40	3.88	4.49	22	24	47
12	982	41	3.91	4.41	21	22	37
13	1243	43	3.68	4.57	22	23	34
14	1411	47	3.87	4.95	23	22	35
mean	1981	35	3.2	4.4	18	37	37
standard dev.	1260	8	0.9	1.1	4	19	22

Table 12. Approximate values of indices characterizing aquatic macroinvertebrate communities in selected Montana rivers during August.

River	Blackfoot River				Bitterroot River		Clark Fork River			Missouri River	
Location	nr. mouth	Johnsrud Park	Hogum	Hogum	Hamilton	nr. mouth	Deerlodge	Turah	b. Milltown Dam	b. Hauser Dam	Great Falls
Data	1986-87	1988	1988	1972	1986	1986	1986-87	1986-87	1986-87	1982	1983
Sample type	Hess	sq ft. Hess	sq.ft. Hess	sq.ft. Hess	kick	Hess	Hess	Hess	Hess	Hess	Hess
Reference	McGuire 87,89	this study	this study	Spence 1975	Kerr 1988	McGuire 87,89	McGuire 1987 and 1989			McGuire 83a	McGuire 83b
total density (#/m2)	4000 7000	13000	20000	17000	-	9000 11000	14000 15000	15000 17000	14000 16000	16000 20000	18000 23000
taxa richness	21-32	43	39	36	41	34 - 37	25 - 30	34 - 36	36 - 43	30	30 to 45
EPT richness	18-19	22	19	21	21	16 - 17	10 - 14	18 - 19	19 - 23	10	13 - 15
Shannon diversity	3.3-3.9	3.7	3.5	3.6	4	3.6 - 3.7	1.7 - 2.3	3.7 - 3.3	3.4 - 3.9	2.7	3.0
biotic index (0-10)	5.3	4.6	4.6	-	3.9	5.3	4.9	4.7	4.9	-	-

Figure 29. Single-linkage cluster analysis of Percent Community Similarity coefficients for 14 stations on the Blackfoot River during August, 1988.

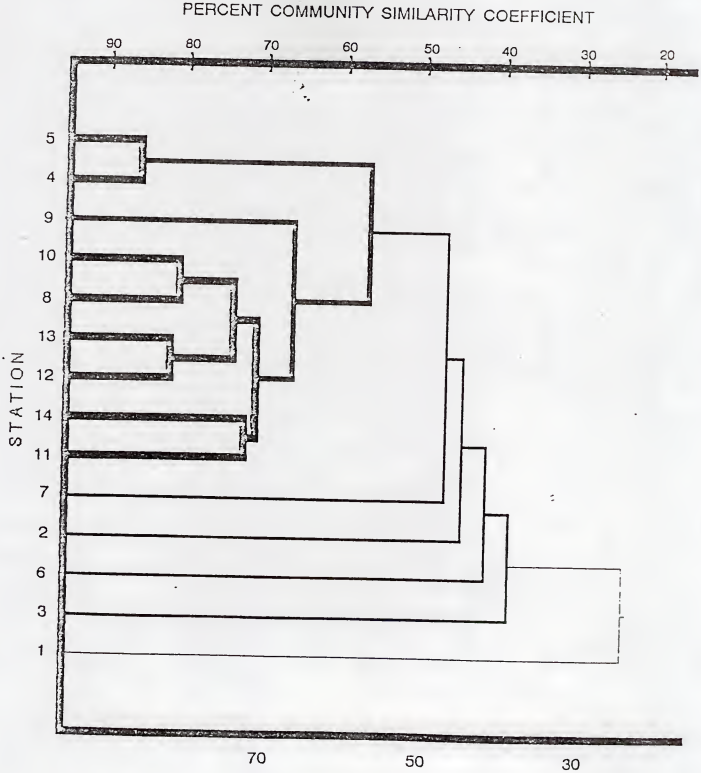


Figure 30. Mean macroinvertebrate density (# per square foot sample) at 14 stations on the Blackfoot River during August, 1988.

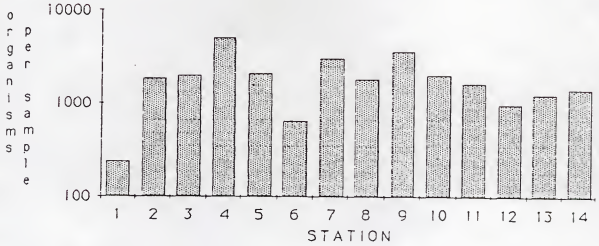


Figure 31. Mean taxa richness (# taxa per sample) at 14 locations on the Blackfoot River during August, 1988.

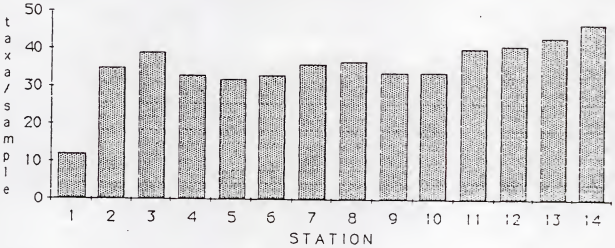


Figure 32. Mean EPT richness (mayfly, stonefly and caddisfly taxa per sample) at 14 locations on the Blackfoot River during August, 1988.

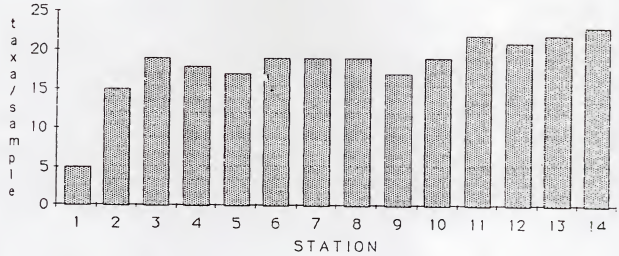


Figure 33. Mean Shannon diversity at 14 stations on the Blackfoot River during August, 1988.

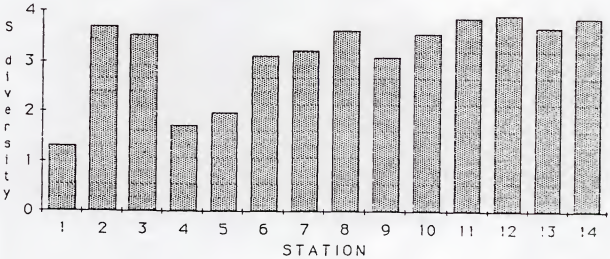


Figure 34. Mean biotic index values at 14 stations on the Blackfoot River during August, 1988.

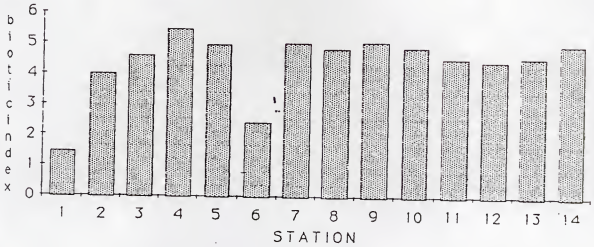


Figure 35. Mean percent relative abundance of the numerically dominant macroinvertebrate taxon at 14 locations on the Blackfoot River during August, 1988.

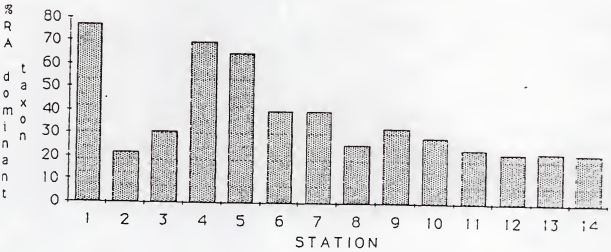


Figure 36. Mean percent relative abundance of filter-feeding macroinvertebrates at 14 locations on the Blackfoot River during August, 1988.

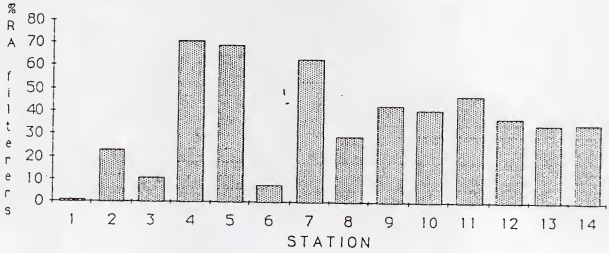


Figure 37. Relative abundance of aquatic insect orders at 14 locations in the Blackfoot River during August, 1988.

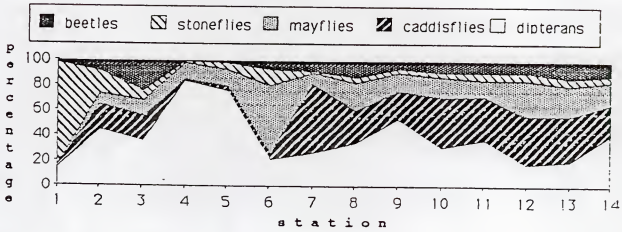


Figure 38. Relative abundance of aquatic insect orders at six locations in the Blackfoot River during August, a) 1971 b) 1972 and c) 1988.

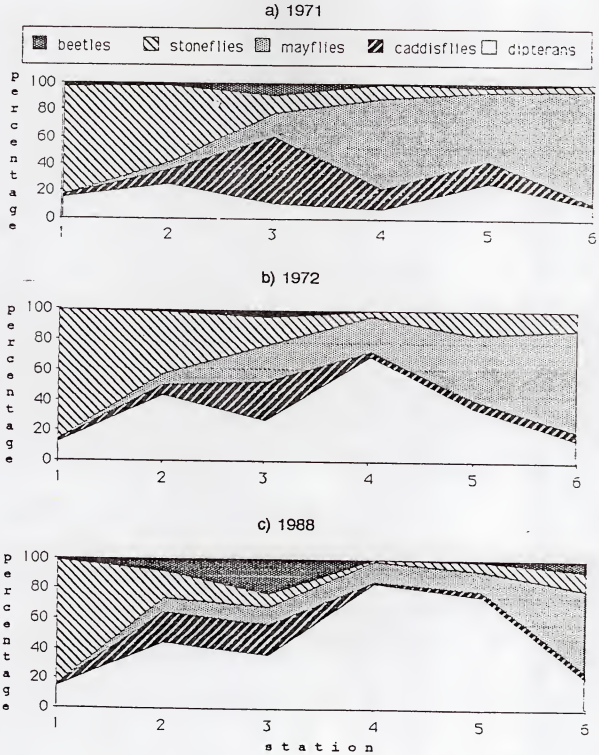


Figure 39. Mean macroinvertebrate density (# per square foot sample) at seven stations on the Blackfoot River during August, 1971, 1972 and 1988.

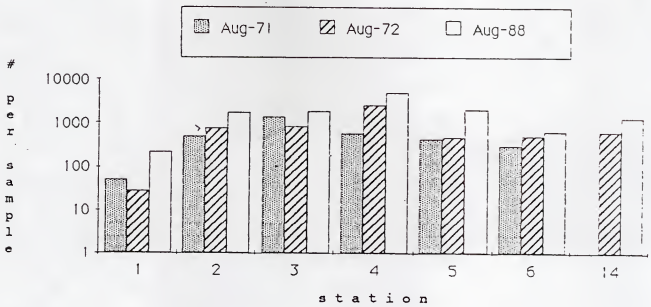
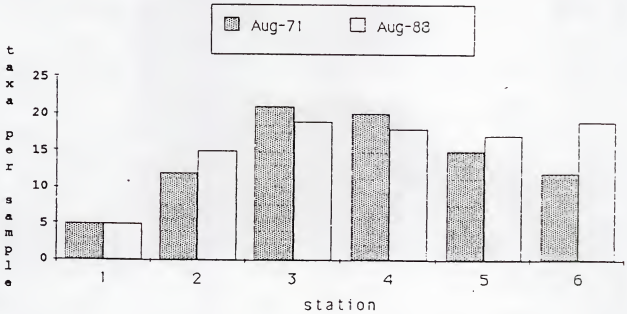


Figure 40. Mean EPT richness (mayfly, stonefly and caddisfly taxa per sample) at six locations on the Blackfoot River during August, 1971 and 1988.



5.5 Priority Pollutant Analyses

Results of the priority pollutant analyses conducted on water samples from five different locations on the Blackfoot River are included in Appendix E. The analytical results were reviewed and compared to published water quality criteria. Due to the lengthy list of compounds analyzed, individual criteria are not listed here. The reader is referred to the U.S. EPA water quality criteria document (U.S. EPA, 1986) for specific standards and additional information on the compounds analyzed.

Of the more than 120 organic compounds tested for, only one was measured in concentrations above the analytical detection limit. This compound was the priority pollutant bis (2-ethylhexyl) phthalate (DEHP). It was found in concentrations ranging up to 5.2 ug/l. Highest concentrations were measured at the Helmville and Roundup Bar bridges during spring runoff.

DEHP is a phthalate ester, and is commonly used as a plasticizer (an additive that gives rigid plastic flexibility). Its migration out of plastics is slow, although soluble complexes may aid their mobility. The water quality criteria for DEHP are 940 ug/l (acute) and 3 ug/l (chronic). Several measurements during runoff conditions in April 1989 exceeded the chronic criterion. EPA's Denver office reports that it is common in the environment and could have resulted from sample contamination in the lab or field. There is no known source of phthalate esters in the Blackfoot River and as such, the data are somewhat suspect.

The analytical results for priority organic pollutants in the Blackfoot drainage do not necessarily rule out the possibility of intermittent or infrequent problems of this nature. However, they suggest that a serious problem from organic chemicals does not exist and confirm that pollutants of this nature were not responsible for the observed chronic toxicity bioassay results.

5.6 Streamflow Trend Analyses

The statistical analysis of historic streamflow patterns using the Kendall Tau test did not reveal any significant long-term trends. No significant increase or decrease in total annual discharge was detected in the 49-year period of record. A weak declining trend (80% confidence level) was detected for spring streamflows, which was defined as April, May and June. No significant increasing or decreasing trend was detected for summer (July-September), fall (October-December) or winter (January-March).

The results do not indicate that silvicultural activities are not having an impact on the Blackfoot River. Impacts of clearcutting may be more localized and confined to the immediate drainage of concern. It is possible that natural variability of hydrologic events and climatic patterns largely overwhelm our ability to detect impacts due to land use activities on a scale as large as the Blackfoot River.

6. CONCLUSIONS

Based on previous discussions of monitoring results, the following conclusions can be made about water quality conditions and pollutant sources in the Blackfoot River Basin during 1988-1989.

Streamflows in 1988-1989 and Historical Patterns

The 1988-1989 monitoring period was marked by large variations in streamflow, thus providing a good opportunity to document water quality characteristics during both extreme low and unusually high streamflow. The above-normal spring runoff of 1989 also allowed us to examine concentrations of suspended sediment and other pollutants during the first major flushing flows following several years of extreme drought.

An analysis of trends in total Blackfoot Basin water discharge and timing of runoff over a 49-year period of record indicated no significant changes resulting from extensive timber harvest in the drainage. No significant upward or downward trend was noted for streamflows during summer, fall, or winter periods. A weak trend of declining spring streamflows was indicated. However, long-term weather patterns could have had an influence.

Basic Water Quality Characteristics

The water chemistry of the Blackfoot River was markedly influenced by inputs of mine effluent in the headwaters. Alkalinity and pH were depressed for some 20 river miles due to the effects of acid mine drainage. Water hardness and concentrations of dissolved minerals were elevated for more than 10 river miles due to the dissolution of mineral ions by the acid discharges.

Inflows of limestone groundwater or springs below Lincoln increased the potential fertility of the Blackfoot River and enhanced its buffering capacity against changes in pH and the effects of metals.

Water hardness and other variables were reduced during the high, dilutional flows of runoff, leaving resident biota more susceptible to toxic effects of metals from headwaters sources.

The middle and lower Blackfoot River had moderate levels of dissolved minerals, alkalinity and water hardness, which were generally comparable to other west slope streams. These variables have an influence on a river's ability to support aquatic life. By comparison to productive east slope fisheries such as the Madison or Beaverhead rivers, the Blackfoot River is probably somewhat limited in its ability to support high densities of fish due to its basic water chemistry.

Suspended Sediment and Turbidity

Concentrations of suspended sediment and turbidity in the Blackfoot River were minimal during low streamflows and no significant sources or problems were indicated.

Most of the total sediment discharge in the basin occurred during a relatively brief spring runoff period. Landers Fork, Nevada Creek, and the North Fork appeared to be the largest sources of sediment discharge to the Blackfoot River. Nevada Creek discharged the bulk of its sediment load early in the spring runoff period and had a major influence on suspended sediment concentrations downstream in the Blackfoot River. Landers Fork and the North Fork discharged the most sediment during peak snowmelt later in the runoff period. Sediment discharged from the North Fork in 1989 may have been heightened by the 1988 Canyon Creek fire

which burned much of the North Fork watershed. Due to its location in the headwaters area, Landers Fork degraded more miles of the Blackfoot River with elevated sediment concentrations than the other tributaries.

Longer-term monitoring data suggested that suspended sediment concentrations in the Blackfoot River during spring 1989 were higher and elevated for a longer period than during any of the past five years. This information supports the hypothesis that fine sediments may have accumulated in the river during the recent drought years.

Heavy Metals

Metals from historic mining activities in the Blackfoot River headwaters were clearly the most acute water quality problem in the watershed.

Water column concentrations of heavy metals were highest during the first part of spring runoff and the zone of effect was extended downstream during runoff, indicating that nonpoint sources (e.g. streamside and stream channel tailings material, precipitated metal salts) may be more important overall than point sources (e.g. Mike Horse adit discharge). The threat of metals to aquatic life was exacerbated during runoff conditions due to reduced water hardness and its effect on metals toxicity.

At least 10 to 12 miles of the upper Blackfoot River periodically experience potentially damaging water column concentrations of heavy metals. Concentrations of copper, lead, and cadmium exceeded aquatic life toxicity criteria levels in the upper five to seven miles of the Blackfoot River during spring runoff. Zinc was a more widespread and persistent problem. Instream zinc concentrations exceeded toxicity criteria values in the upper 10-12 miles of the river during higher flows and up to

five miles of the river during low flows.

During the 1989 runoff period, water column metals concentrations were elevated and detectable throughout the length of the river, although concentrations in most of the river were well below the applicable criteria. Water column metals concentrations did not appear to be a serious problem below the Hogum Creek road bridge.

Instream metals concentrations in 1988-1989 were generally within the ranges of concentrations reported for 1968-1973.

Algal Nutrients

Nutrient concentrations in the Blackfoot River were generally low, except during runoff conditions when nonpoint source inputs of nutrients were evident.

Nevada Creek was a readily apparent source of bioavailable phosphorus during runoff. Its discharge increased downstream Blackfoot River concentrations to above levels which would be expected to limit development of nuisance algal growths. The presence of noxious densities of filamentous green algae in the Blackfoot River from the Nevada Creek confluence nearly to the North Fork may have been influenced by nutrient loading from the Nevada Creek watershed. Nutrient concentrations in Nevada Creek during May 1989 were well above those in all other monitored Blackfoot River tributaries.

Elevated concentrations of ammonia-nitrogen in the Blackfoot River downstream of Nevada Creek during April 1989 pointed to the presence of agricultural or feedlot runoff. Sustained downstream ammonia concentrations indicated the presence of more than one source.

Landers Fork, the North Fork, and Elk and Union creeks contained high total phosphorus concentrations during high flows, relative to other tributaries. Phosphorus concentrations in these tributaries were believed to be primarily attributable to elevated sediment concentrations.

Landers Fork, Chamberlain Creek and Elk Creek had somewhat elevated nitrogen concentrations, suggesting moderate nonpoint source pollution problems.

Overall, the Blackfoot River was relatively nutrient-poor when compared to other Clark Fork Basin streams and various east slope rivers. Low nutrient concentrations in much of the river may limit its inherent fertility with respect to fish production. Conversely, its nutrient-poor status undoubtedly contributes to its water clarity, relatively algae-free stream bottom, and overall esthetic appeal relative to many other rivers.

Chronic Toxicity Bioassays

Toxicity in the upper reaches of the Blackfoot River (Meadow Creek to Flesher Pass Road) was conclusive and was supported by water quality data demonstrating concentrations of copper, zinc, cadmium and lead which exceeded criteria for the protection of aquatic life. The extent of toxicity may be farther downstream during high flows than was observed in these bioassays. The cause of toxicity was probably mine drainage from the Mike Horse Mine area and/or the Carbonate Mine along Highway 200.

Toxic effects (increased mortality and/or depressed reproduction) occurred in waters collected from the middle reaches of the river (approximately sites 5 through 10) in two of the three bioassays (low flow bioassays). Because water quality testing did not identify toxicants, it could be that the "toxicity" was not

real but was related to other factors (inappropriate control; contamination; an unidentified toxicant; acclimation problems between control and mainstem). The pattern of toxicity (good relationship between mortality and poor reproduction; consistency between bioassays; steadily decreasing reproduction in a downstream direction) suggest that the toxicity was real. The failure to identify the presence of the most suspect toxicants (ammonia, heavy metals, other priority pollutants) suggest the toxicity was not real. Perhaps the toxicity was real and the cause remains unidentified.

Macroinvertebrate Community Structure

The aquatic insect community in the Blackfoot River during August 1988 was a good indicator of biological integrity and water quality conditions.

From the headwaters downstream to the Flesher Pass road, heavy metals pollution was the overwhelming problem and the macroinvertebrate community exhibited numerous indications of metals-related stress. The benthic community in the upper Blackfoot was virtually unchanged from that described in the early 1970s.

Community structure in the middle Blackfoot River, from Hogum Creek to the Helmville Bridge, indicated generally good water quality. However, reduced biological integrity pointed to a combination of subtle environmental stresses. The most discernible impacts were from slight to moderate levels of organic and/or nutrient enrichment. In addition, habitat degradation associated with sediment deposition was suggested at two locations. Other drought-related factors, including reduced habitat availability due to low steamflows, elevated summer water temperatures, enhanced growth of aquatic vegetation, and reduced bedload transport and scouring may have influenced the reduced biological integrity found

in the middle river. Changes in benthic community abundance, taxonomic composition and the relative abundance of functional groups were apparent when compared to early 1970's conditions.

The macroinvertebrate community in the lower Blackfoot River below the North Fork appeared to be entirely healthy and no significant water quality or habitat degradation was evident.

Priority Pollutant Analyses

Of more than 120 toxic organic compounds which were tested for, only one was present in the Blackfoot River in concentrations above the limit of analytical detection.

The compound was a phthalate ester which is common in the environment and whose presence in the samples may have resulted from contamination in the field or in the lab.

Phthalate concentrations were below human health standards but slightly exceeded the chronic toxicity criterion for freshwater aquatic life at some locations during spring runoff. However, as suggested, the results may not be valid.

Synopsis

Our 1988-1989 stream monitoring in the Blackfoot River Basin provided answers to many water quality-related questions about the river system. The results have improved our understanding of the extent and severity of pollution problems in the Blackfoot Basin. While suspected problems were confirmed and new ones identified, the overall synopsis, at least on the surface, appears optimistic:

1) While several miles of the Blackfoot's headwaters remain seriously polluted, water quality conditions and the benthic community appear to be much the same as in the early 1970s.
2) Water quality problems in the middle reaches of the river were relatively subtle and resulted from moderate nonpoint source pollution which may have been exacerbated by a prolonged drought.
3) The lower river below the North Fork was generally in excellent condition relative to water quality and biological health.

Why, then, has the river's aquatic community, and especially its fishery, declined from its former status? Perhaps the real issue has eluded our best efforts. Just as stress or an unhealthy lifestyle can sap the vitality of an otherwise health human being and a diagnosis cannot be made, it is possible that a combination of nearly undetectable chronic stresses are taking their toll on the Blackfoot River. Aquatic ecosystems are exceedingly complex and the cumulative effects of many seemingly minor actions may result in serious complications over time. As an example, Figure 41 demonstrates some possible effects of watershed alterations and the interrelatedness of water quality variables.

Quite likely, the recent drought years have magnified the river's response to the myriad of potential stresses in the watershed through a diminished ability to metabolize or flush pollutants. Granted, problems have not only become apparent during

the drought, but things appear to have gotten worse. This suggests that the Blackfoot River may be approaching a threshold level of stress. While the situation will likely improve with the years of higher streamflows that are sure to come, the real problems will not have been resolved.

In our minds, the biggest question which remains unanswered is that of the effects of deposited sediments in the Blackfoot watershed. Our study did not address this issue, nor have other investigations to date thoroughly explored it. Gradual increases in sediment delivery or deposition rates either in tributaries or the mainstem, can have serious consequences over time. Expected effects include decreased reproductive rates for trout, increasing water temperatures, reduced habitat quality and decreased availability of food. All the while, water quality may remain relatively high. Future monitoring efforts should concentrate in the area of habitat quality, sediment deposition rates, substrate composition and embeddedness.

ecological impact of human-induced alterations

1. energy source
   - type, amount, and particle size of organic material entering a stream from the riparian zone versus primary production in the stream
   - seasonal pattern of available energy

   → decreased coarse particulate organic matter
   → increased fine particulate organic matter
   → increased algal production

2. water quality
   - temperature
   - turbidity
   - dissolved oxygen
   - nutrients (primarily nitrogen and phosphorus
   - organic and inorganic chemicals, natural and synthetic
   - heavy metals and toxic substances
   - pH

   → expanded temperature extremes
   → increased turbidity
   → altered diurnal cycle of dissolved oxygen
   → increased nutrients (especially soluble nitrogen and phosphorus)
   → increased suspended solids

3. habitat quality
   - substrate type
   - water depth and current velocity
   - spawning, nursery, and hiding places
   - diversity (pools, riffles, woody debris)

   → decreased stability of substrate and banks due to erosion and sedimentation
   → more uniform water depth
   → reduced habitat heterogeneity
   → decreased channel sinuosity
   → reduced habitat area due to shortened channel
   → decrease instream cover and riparian vegetation

4. flow regime
   - water volume
   - temporal distribution of floods and low flows

   → altered flow extremes (both magnitude and frequency of high and low flows)
   → increased maximum flow velocity
   → decreased minimum flow velocity
   → reduced diversity of microhabitat velocities
   → fewer protected sites

5. biotic interactions
   - competition
   - predation
   - disease
   - parasitism

   → increased frequency of diseased fish
   → altered primary and secondary production
   → altered trophic structure
   → altered decomposition rates and timing
   → disruption of seasonal rhythms
   → shifts in species composition and relative abundances
   → shifts in invertebrate functional groups (increased scrapers and decreased shredders)
   → shifts in trophic guilds (increased omnivores and decreased piscivores)
   → increased frequency of fish hybridization

Figure 41. Five major classes of environmental factors that affect aquatic biota. Arrows indicate the kinds of effects that can be expected from human activities, in this case the alteration of headwater streams, excluding small impoundments (modified from Karr et al. 1983, in Karr et al. 1986)

7. RECOMMENDATIONS

The following are measures suggested by the authors as appropriate to further our understanding of the Blackfoot River ecosystem and to address known or suspected sources of water quality and fisheries impairment:

Eliminate or reduce inputs of mine effluent and runoff from mine spoils in headwaters drainages:

Mining-related impacts are clearly the most acute water quality problems in the Blackfoot Basin. Sources such as the Mike Horse, Paymaster and Carbonate mine sites cause acute or chronic toxicity and restrict fisheries in at least the upper eight miles of the mainstem of the Blackfoot River and essentially sterilize many more miles of tributary streams. Elevated metals concentrations in fish organs, benthic animals, and bottom sediments persist in much of the river and indicate an unhealthy environment and a source of stress to the aquatic community which can and should be reduced. The MDHES Water Quality Bureau should provide support, assistance and guidance to sponsors of the state RIT grants program Blackfoot mines reclamation projects scheduled for 1990 to insure effective, long-term control or elimination of mine waste inputs to the river.

Inventory/evaluate tributary sediment sources and implement effective erosion control measures:

Sediment loading from Nevada Creek has been shown to degrade water quality and impair beneficial water uses in many miles of the Blackfoot River. Sediment sources to Nevada Creek are suspected to be largely man-caused due to the intensive land and water use activities in the watershed. A physical features inventory of the Nevada Creek drainage will be conducted by the Water Quality Bureau in the fall of 1990. Significant sediment sources should be

considered for remediation under the Bureau's Section 319 Nonpoint Source Pollution Control Program.

Landers Fork and North Fork appear to be two of the three largest sources of sediment loading to the Blackfoot River. These streams should be inventoried to determine if sediment inputs are largely natural or are aggravated by silvicultural and other land use activities. Remediation activities should be considered if practical. At a minimum, land use planners (USFS, BLM, etc) should be made aware of existing sediment sources and sediment-related impacts to the Blackfoot ecosystem. Existing impacts need to be thoroughly considered in the evaluation of cumulative effects from ongoing silvicultural and road building activities in the Blackfoot Basin.

Nonpoint sources of unnatural sediment production in tributaries such as Union, Elk, Monture, and Chamberlain creeks should be identified and corrective recommendations developed. The Bureau recently contracted with a private party to conduct a sediment source survey of the Union Creek drainage. This study provides a model for a suitable assessment approach.

Evaluate the effects of current sediment delivery rates to the aquatic community and establish instream criteria:

Substrate composition and embeddedness measurements by the Montana Department of Fish, Wildlife and Parks should be continued in representative reaches of the Blackfoot River and its tributaries. These data, when compared to the literature, should define the current level of impact to the aquatic community from fine sediment deposition. Comparisons should be made of reaches above and below known sediment sources and in steep and low gradient segments of the river. The goal should be to assess sediment deposition problems and sources, and to develop instream criteria which will provide the needed level of protection for the

fishery and associated aquatic life. These criteria would provide a basis for evaluating potential impacts to the designated B-1 water uses from proposed development activities.

Evaluate nutrient/algae relationships in the Blackfoot River and identify and control nutrient sources in the Nevada Creek drainage if needed:

The Blackfoot River from Nevada Creek to the North Fork supports nuisance levels of noxious filamentous algae. Algal mats also appeared to act as sediment traps which reduced river substrate quality. The relationship between those localized algae and the seasonally elevated nutrient concentrations in this reach of river needs to be determined.

Nevada Creek appeared to be the single most significant tributary source of nutrient loading to the Blackfoot River. It was almost certainly responsible for the elevated nutrient concentrations in the reach of the Blackfoot which was plagued by algae. If reducing nutrient concentrations can be expected to limit the occurrence of algae, nutrient sources to Nevada Creek should be identified and controlled.

Confirm or disprove the apparent chronic toxicity in the middle Blackfoot River and identify toxicants:

The authors were unable to determine if the apparent chronic toxicity in several reaches of the river during summer 1989 and winter 1990 was real because toxicants were not detected. We recommend that toxicity testing (Ceriodaphnia or other bioassays) and chemical analyses be repeated at the stations in question during late summer 1990. A failure to confirm or refute the results of the earlier tests would be to ignore a potentially significant problem.

Establish a baseline record of water temperature regimes for key reaches of the Blackfoot River and its tributaries:

One potential result of widespread deforestation and increased sediment delivery rates is gradually increasing water temperatures. Subtle changes in water temperature regimes can have devastating effects on cold water aquatic ecosystems. While historical water temperature data for the river is limited, a detailed record of current conditions should be made to serve as a baseline for future comparison. Continuous recording thermographs could be installed at various locations from early spring through the fall period. This work could be done by the DFWP or under contract with the U.S. Geological Survey.

Reevaluate the macroinvertebrate community composition in the middle reaches of the Blackfoot River following the high streamflows of spring 1989:

Macroinvertebrate samples were collected from seven locations in the middle and lower reaches of the Blackfoot River in August 1989. Data for most of these stations from August 1988 indicated reduced biological integrity when compared to records for the early 1970s. Drought-related factors were suspected as causing the observed macroinvertebrate community impairment. The 1989 samples should be processed and the data evaluated to determine if the high streamflows of 1989 improved biological conditions in the river. This information would increase our understanding of possible drought and sediment-related problems in the river. The data would also allow an evaluation of the effects of the Canyon Creek fire and increased sediment loading from the North Fork on the Blackfoot River. It is anticipated that the Water Quality Bureau will be able to fund this relatively inexpensive project in the summer of 1990.

Compile economic data to show the recreational value of the Blackfoot River:

Some of this information was developed by the University of Montana Economics Department for DFWP (Duffield et al, 1987, 1988). It could be expanded as needed to show the tradeoffs to other uses of resource development activities in the Blackfoot Basin. The Blackfoot River is one of the most heavily floated and fished rivers in western Montana. Economic data would provide hard evidence of the value lost if we fail to preserve the resource and would be a convincing argument in support of sound resource management, reclamation and study grants, and government funding.

Promote cooperation between researchers, resource managers, private industry, citizen's groups and the general public:

Communications should be enhanced between all parties with interest in the Blackfoot River Basin. Information should be shared and resources pooled in order to protect the river, further define its problems and threats, and to initiate corrective measures. The Big Blackfoot Chapter of Trout Unlimited has successfully led this effort in the past and should be encouraged to continue its role as a grassroots resource management committee.

Carefully monitor new land use/resource development projects in the Blackfoot Basin for potential impacts to the river:

Baseline monitoring is essential to establish existing water quality conditions prior to new project implementation. Water quality and fisheries problems and causes need to be identified in advance so that the consequences of additive stresses can be fully evaluated. Adequate project-specific water quality monitoring programs should be an integral part of all resource extraction

activities. Cumulative effects of unrelated projects on both public and private lands in the basin need to be better assessed so that gradual long-term degradation of water quality and fishery resources can be prevented.

Water quality and fisheries management agencies should direct more funding and effort toward preserving existing high quality watersheds:

The Blackfoot River situation should tell us that we cannot afford to take our healthy aquatic ecosystems for granted. We know that such waterbodies are susceptible to slow degradation over time if we allow it. More resources need to be allocated to documenting current water quality conditions and fish populations in our best watersheds so that nondegration water quality statutes can be more adequately enforced and preventative measures can be taken before problems develop. Our inability to completely resolve questions today about the Blackfoot River's health stem from our failure to have assembled a thorough body of scientific information in the past.

Continue to support the development of the Blackfoot River Basin Geographical Information System (GIS) and water quality model by the U.S. EPA and implement its use in all resource management planning and development activities in the basin:

The Blackfoot GIS system is being developed under the three-year, three-state assessment of the Clark Fork-Pend Oreille Basin authorized under Section 525 of the 1987 Amendments to the federal Clean Water Act. It is the first river basin-wide application of a GIS as a water quality management tool. The system will include an integral water quality model which will allow predictions of changes in water quality resulting from various activities in the basin. The system will be completed in 1990. Its use as a planning tool should be widely implemented and joint funding should be secured to insure its continued maintenance and operation.

8. LITERATURE CITED

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APPENDICES A-D

BLACKFOOT RIVER AQUATIC

MACROINVERTEBRATE DATA

Appendix A. Aquatic macroinvertebrates identified in August, 1988 samples from the Blackfoot River, Montana.

order	family	genus/species	common name
EPHEMEROPTERA			mayflies
	Siphlonuridae	*Ameletus sp.*	
	Baetidae	*Baetis insignificans*	
		Baetis tricaudatus	
		Psuedocloeon sp.	
	Heptageniidae	*Cinygmula sp.*	
		Epeorus albertae	
		Rhithrogena sp.	
	Ephemerellidae	*Attenella margarita*	
		Ephemerella inermis/infrequens	
		Drunella coloradensis	
		Drunella doddsi	
		Drunella grandis	
		Serratella tibialis	
		Timpango hecuba	
	Leptophlebiidae	*Paraleptophlebia sp.*	
	Tricorythidae	*Tricorythodes minutus*	
DIPTERA			true flies
	Tipulide		craneflies
		Antocha sp.	
		Dicranota sp.	
		Hexatoma sp.	
		unidentified larva	
	Psychodidae		moth flies
		Pericoma sp.	
	Ceratopogonidae		biting midges
		Ceratopogoninae	
	Simuliidae		blackflies
		Simulium spp.	
		(s.g. Psilozia)	
		(s.g. Eusimulium)	
	Athericidae		snipe flies
		Atherix pachpus	
	Empididae		dance flies
		Chelifera sp.	
		Clinocera sp.	
	Pelecorhynchidae	*Glutops sp.*	

Appendix A. Aquatic macroinvertebrates identified in August, 1988 samples from the Blackfoot River, Montana.

order	family	genus/species	common name
DIPTERA (continued)			true flies
	Chironomidae		midges
	Tanypodinae	Thienemannimyia gp.	
		Pentaneura sp.	
	Diamesinae	*Diamesa sp.*	
		Pagastia sp	
		Potthastia longimanus gp.	
		Potthastia gaeddi gp.	
	Orthocladiinae	*Brillia sp.*	
		Cardiocladius spp.	
		Corynoneura sp	
		Cricotopus spp.	
		C. (Isocladius) sp., C. (Nostococladius) sp., C. (C.) bicinctus, tremelus & trifascia gps.	
		Eukiefferiella spp.	
		E. brehmi, claripennis gp. devonica gps.	
		Lopescladius sp.	
		Orthocladius spp.	
		O. (Ortho.) &(Euorthorthocladius.)	
		Nanocladius sp.	
		Paraphaenocladius spp.	
		Rheocricotopus sp.	
		Synorthocladius sp.	
		Thienemanniella sp.	
		Tvetenia sp.	
	Chironominae		
	Chironomini	*Cryptochironomus sp.*	
		Demicryptochironomus sp.	
		Microtendipes sp.	
		Phaenopsectra sp.	
		Polypedilum spp.	
		Robackia sp.	
		Xenochironomus sp.	
	Tanytarsini	*Cladotanytarsus sp.*	
		Micropsectra spp.	
		Rheotanytarsus sp.	

Appendix A. Aquatic macroinvertebrates identified in August, 1988 samples from the Blackfoot River, Montana.

order	family	genus/species	common name
TRICHOPTERA			caddisflies
	Philopotamidae	*Wormaldia sp.*	
	Psychomyiidae	*Psychomyia sp.*	
	Polycentropidae	*Crynellus sp.*	
	Hydropsychidae	*Arctopsyche grandis*	
		Parapsyche elsis	
		Cheumatopsyche spp.	
		Hydropsyche spp.	
		H. (Ceratopsyche) spp.	
		H. (C.) cockerelli, tana and oslari?	
		H. (Hydropsyche) spp.	
		H. (H.) occidentalis	
	Rhyacophilidae	*Rhyacophila spp.*	
		R. angelita sp.	
		R. betteni gp.	
		R. brunnea gp.	
		R. coloradensis gp.	
		R. iranda gp.	
	Glossosomatidae	*Agapetus sp.*	
		Culoptila sp	
		Glossosoma sp.	
	Hydroptilidae	*Hydroptila spp.*	
		Ochrotrichia sp	
		Leucotrichia pictipes	
		Zumatrichia notosa	
	Brachycentridae	*Brachycentrus americanus*	
		Brachycentrus occidentalis	
		Micrasema sp.	
	Lepidostomatidae	*Lepidostoma sp.*	
	Limnephilidae	*Apatania sp.*	
		Dicosmoecus sp.	
		Neophylx sp.	
	Helicopsychidae	*Helicopsyche sp.*	
	Leptoceridae	*Ceraclea sp.*	
		Oecetis sp.	
COLEOPTERA			beetles
	Elmidae		riffle beetles
		Optioservus spp.	
		Zaitzevia sp.	
		Cleptelmis ornata	
		Heterlimnius corpulentus	
		Larra avara	
		Stenelmis sp.	
		Narpus concolor	
	Haliplidae		crawling water beetles
		Brychius sp.	

Appendix A. Aquatic macroinvertebrates identified in August, 1988 samples from the Blackfoot River, Montana.

order	family	genus/species	common name
PLECOPTERA			stoneflies
	Perlidae	*Calineuria californica*	golden stoneflies
		Claassenia sabulosa	"
		Hesperoperla pacifica	"
	Perlodidae	*Cultus sp.*	summer brown
		Isogenoides sp.	"
		Skwala sp.	
	Chlloroperlidae	*Chloroperlinae*	
		Kathroperla sp.	
	Nemouridae	*Amphinemura sp.*	
		Zapada cinctipes	
	Capniidae	*Capnia gp.*	winter stonefly
	Pteronacidae	*Pteronarcella badia*	
		Pteronarcys californica	salmonfly
LEPIDOPTERA			moths
	Pyralidae	*Petrophila sp.*	
HEMIPTERA			true bugs
	Corrixidae	*Sigara alternata*	water boatmen
ODONATA			dragonflies
	Gomphidae	*Ophiogomphus sp.*	
ANNELIDA			segmented worms
	Enchytraediae		
	Lumbricidae		
	Lumbriculidae		
	Tubificidae		
MOLLUSCA			
Gastropoda			snails
	Lymnaeidae		pond snails
	Planorbidae	*Gyraulus sp.*	
	Physidae		
	Ancyclidae	*Ferrissia sp.*	limpets
Pelecypoda			
	Sphaeriidae		fingernail clams
TURBELLARIA			flatworms

Appendix B:

Blackfoot River macroinvertebrate data

for August, 1988

Scraper

MACROINVERTEBRATE DATA								
BLACKFOOT RIVER below Meadow Cr. - STATION 1 - 8/10/88								
Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						1%	2	
Optioservus spp.	0	2	2	0	4	0%	1.0	1.2
Zaitzevia sp.	0	0	1	0	1	0%	0.3	0.5
Heterlimnius corpulentus	0	1	1	0	2	0%	0.5	0.6
DIPTERA						15%	35	
Thienemannimyia gp.	1	0	0	0	1	0%	0.3	0.5
Pagastia sp	39	23	6	7	75	8%	18.8	15.6
Corynoneura sp	2	0	0	0	2	0%	0.5	1.0
Cricotopus (C.) tremelus gp	19	4	4	3	30	3%	7.5	7.7
Eukiefferiella spp.	2	2	4	15	23	2%	5.8	6.2
Dicranota sp.	1	0	0	0	1	0%	0.3	0.5
Simulium sp.	0	0	1	3	3	0%	1.0	1.4
Chelifera sp.	2	2	0	1	5	1%	1.3	1.0
Ceratopogoninae	1	1	0	0	2	0%	0.5	0.6
PLECOPTERA						83%	198	
Amphinemura sp	0	0	1	2	3	0%	0.8	1.0
Zapada cinctipes	128	166	291	159	744	78%	186.0	71.9
Chloroperlinae	9	4	14	9	36	4%	9.0	4.1
Kathroperla sp.	1	0	0	0	1	0%	0.3	0.5
Perlodidae	2	0	1	3	6	1%	1.5	1.3
TRICHOPTERA						1%	3	
Parapsyche elsis	0	0	0	1	1	0%	0.3	0.5
Lepidostoma sp.	1	0	1	0	2	0%	0.5	0.6
Rhyacophila betteni gp.	3	2	1	1	7	1%	1.8	1.0
TOTAL ORGANISMS	211	207	328	204	949		238	60
TAXA RICHNESS	14	10	13	11	20		12	1.8
SHAN. DIVERSITY	1.92	1.16	0.83	1.37	1.38		1.32	0.46
BIOTICINDEX	1.72	1.28	1.17	1.66	2.25		1.46	0.27
EPT RICHNESS	6	3	6	6	8		5	1.5
EPT / CHIR.	2.29	5.93	22.07	7.00	6.11		9.3	8.7
% R.A. DOMINANT	61%	80%	89%	78%	78%		77%	11.8%
% R.A. FILTERERS	0%	0%	0%	2%	0%		1%	0.9%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Flesher Pass Rd. Br. - STATION 2 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						8%	142.	
Optioservus spp.	0	0	1	0	1.	0%	0.3	0.5
Zaitzevia sp.	93	57	88	305	543	7%	135.8	114.0
Heterlimnius corpulentus	4	0	9	0	13	0%	3.3	4.3
Larraavara	0	0	1.	0	1.	0%	0.3	0.5
Narpus concolor	0	0	5	3	8	0%	2.0	2.4
DIPTERA						45%	840	
unassociated midge pupa	0	2	5	6	13	0%	3.3	2.8
Thienemannimyia gp.	3	6	0	0	9	0%	2.3	2.9
Pentaneura sp.	0	0	1	0	1	0%	0.3	0.5
Diamesa spp.	70	234	58	43	405	5%	101.3	89.2
Pagastia sp	4	23	3	1	31	0%	7.8	10.2
Potthastia gaedii	17	101	35	14	167	2%	41.8	40.6
Cardiocladius spp.	0	1	2	1	4	0%	1.0	0.8
Corynoneura sp	0	1	0	0	1	0%	0.3	0.5
Cricotopus spp.	84	197	69	60	410	5%	102.5	63.8
Eukiefferiella spp.	16	57	84	35	192	3%	48.0	29.3
Thienemanniella sp.	0	1	0	0	1	0%	0.3	0.5
Orthocladius spp.	0	5	6	2	13	0%	3.3	2.8
Paraphaenocladius sp.	9	18	1	7	35	0%	8.8	7.0
Rheocricotopus sp.	173	223	24	56	476	6%	119.0	94.4
Tvetenia sp.	72	126	555	159	912	12%	228.0	220.9
Polypedilum spp.	2	1	0	0	3	0%	0.8	1.0
Rheotanytarsus sp.	86	128	34	25	273	4%	68.3	48.1
Micropsectra spp.	17	17	0	34	68	1%	17.0	13.9
Antocha sp.	25	126	72	40	263	4%	65.8	44.7
Hexatoma sp.	0	1	0	0	1	0%	0.3	0.5
Simulium sp.	13	11	5	38	67	1%	16.8	14.6
Pericoma sp	5	3	0	0	8	0%	2.0	2.4
Glutops sp.	0	2	0	0	2	0%	0.5	1.0
Clinocera sp.	0	1	0	0	1.	0%	0.3	0.5
Certatopogoninae	0	3	0	0	3	0%	0.8	1.5
EPHEMEROPTERA						9%	176	
Baetis tricaudatus	145	173	216	166	700	9%	175.0	29.8
Rhithrogena sp.	0	5	0	0	5	0%	1.3	2.5
PLECOPTERA						18%	330	
Classenia sabulosa	4	6	3	13	26	0%	6.5	4.5
Hesperoperla pacifica	3	2	3	10	18	0%	4.5	3.7
Capnia gp.	3	1	0	2	6	0%	1.5	1.3
Amphinemura sp.?	15	5	3	5	28	0%	7.0	5.4
Zapada cinctipes	191	189	166	398	944	13%	236.0	108.6
Periodidae	6	9	4	3	22	0%	5.5	2.6
Chloroperlinae	60	69	41	103	273	4%	68.3	25.9
Kathroperla sp.	0	0	0	1	1	0%	0.3	0.5

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Flesher Pass Rd. Br. - STATION 2 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						20%	382	
Arctopsyche grandis	14	5	15	12	46	1%	11.5	4.5
H. (Ceratopsyche) spp.?	327	248	230	456	1261	17%	315.3	102.9
Limnephilidae	25	32	12	2	71	1%	17.8	13.4
Micrasema sp.	11	8	31	0	50	1%	12.5	13.2
Wormaldia sp.	0	0	0	1	1	0%	0.3	0.5
Brachycentrus americanus	22	36	3	11	72	1%	18.0	14.3
Rhyacophila brunnea gp.	1	1	21	2	25	0%	6.3	9.8
Rhyacophila Iranda gp.	1	0	0	1	2	0%	0.5	0.6
TOTAL ORGANISMS	1521	2134	1806	2015	7476		1869	269
TAXA RICHNESS	32	40	33	33	48		35	3.7
SHAN. DIVERSITY	3.83	4.05	3.50	3.47	3.94		3.71	0.28
BIOTIC INDEX	4.08	4.29	4.18	3.55	4.02		4.03	0.33
EPT RICHNESS	15	15	13	16	18		15	1.3
EPT / CHIR.	1.50	0.69	0.85	2.68	1.18		1.4	0.9
% R.A. DOMINANT	21%	12%	31%	23%	17%		22%	7.8%
% R.A. FILTERERS	30%	20%	16%	27%	23%		23%	6.6%
ID's by D. McGuire								

MACROINVERTEBRATE DATA

BLACKFOOT RIVER atHogum Cr. Rd. Br. - STATION 3 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						23%	473	
Optioservus spp.	199	295	140	822	1456	18%	364.0	311.9
Zaitzevia sp.	46	26	5	252	329	4%	82.3	114.4
Cleptelmis ornata	0	0	0	1	1	0%	0.3	0.5
Heterlimnius corpulentus	33	2	3	2	40	0%	10.0	15.3
Larra avara	0	1	0	0	1	0%	0.3	0.5
Narpus concolor	9	6	1	48	64	1%	16.0	21.6
DIPTERA						36%	735	
unassociated midge pupa	5	4	7	22	38	0%	9.5	8.4
Thienemannimyia gp.	5	11	33	8	57	1%	14.3	12.7
Pagastia sp	9	3	13	0	25	0%	6.3	5.9
Cricotopus spp.	14	12	46	40	112	1%	28.0	17.5
Cricotopus (Nostococladius)	295	463	1008	460	2226	28%	556.5	311.1
Eukiefferiella spp.	30	21	12	16	79	1%	19.8	7.8
Paraphaenocladius sp.	0	1	1	0	2	0%	0.5	0.6
Rheocricotopus sp.	0	2	0	0	2	0%	0.5	1.0
Tvetenia sp.	16	29	14	16	75	1%	18.8	6.9
Polypedilum spp.	0	3	0	0	3	0%	0.8	1.5
Rheotanytarsus sp.	0	0	1	0	1	0%	0.3	0.5
Micropsectra spp.	30	26	27	84	167	2%	41.8	28.2
Antocha sp.	6	2	8	1	17	0%	4.3	3.3
Hexatoma sp.	1	0	2	0	3	0%	0.8	1.0
Certatopogoninae	5	6	12	0	23	0%	5.8	4.9
Simulium sp.	3	53	5	24	85	1%	21.3	23.2
Chelifera sp.	3	3	4	0	10	0%	2.5	1.7
Glutops sp.	3	0	10	2	15	0%	3.8	4.3
Pericoma sp.	16	3	0	0	19	0%	4.8	7.6
EPHEMEROPTERA						12%	244	
Baetis insignificans	0	0	2	0	2	0%	0.5	1.0
Baetis tricaudatus	197	163	174	208	742	9%	185.5	20.6
Serratella tibialis	3	1	8	6	18	0%	4.5	3.1
Drunella grandis	11	12	24	10	57	1%	14.3	6.6
Heptageniidae (small)	27	18	18	1	64	1%	16.0	10.9
Paraleptophlebia sp.	15	10	60	8	93	1%	23.3	24.7
PLECOPTERA						8%	160	
Claassenia sabulosa	4	4	8	9	25	0%	6.3	2.6
Hesperoperla pacifica	8	9	30	10	57	1%	14.3	10.5
Zapada cinctipes	14	16	16	40	86	1%	21.5	12.4
Perlididae (small)	1	3	5	0	9	0%	2.3	2.2
Chloroperlinae	108	87	204	62	461	6%	115.3	62.1

MACROINVERTEBRATE DATA								
BLACKFOOT RIVER at Ilogum Cr. Rd. Br. - STATION 3 - 8/10/88								
Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						20%	394	
Arctopsyche grandis	8	3	20	4	35	0%	8.8	7.8
H. (Ceratopsyche) spp.?	150	146	214	170	680	8%	170.0	31.2
Apatania sp.	2	0	0	0	2	0%	0.5	1.0
Micrasema sp.	108	61	216	50	435	5%	108.8	75.8
Neophylx sp.	1	4	2	0	7	0%	1.8	1.7
Lepidostoma sp.	31	40	78	22	171	2%	42.8	24.6
Wormaldia sp.	0	1	0	0	1	0%	0.3	0.5
Brachycentrus americanus	2	9	28	0	39	0%	9.8	12.8
Rhyacophila angelita sp.	1	0	1	0	2	0%	0.5	0.6
Rhyacophila brunnea gp.	0	1	4	2	7	0%	1.8	1.7
Rhyacophila Iranda gp.	0	7	12	32	51	1%	12.8	13.7
Agapetus sp.	20	79	44	2	145	2%	36.3	33.3
ANNELIDA						0%	4	
Tubificidae	0	1	16	0	17	0%	4.3	7.8
MOLLUSCA						0%	2	
Lymnaea sp.	0	0	1	6	7	0%	1.8	2.9
TOTAL ORGANISMS	1439	1647	2537	2440	8063		2016	554
TAXA RICHNESS	38	42	43	32	50		39	5.0
SHAN. DIVERSITY	3.83	3.62	3.43	3.23	3.70		3.53	0.25
BIOTIC INDEX	4.30	4.62	4.60	4.84	4.62		4.59	0.22
EPT RICHNESS	19	20	21	16	23		19	2.2
EPT / CHIR.	1.76	1.17	1.01	0.98	1.14		1.2	0.4
% R.A. DOMINANT	21%	28%	40%	34%	28%		31%	8.2%
% R.A. FILTERERS	11%	13%	11%	8%	10%		11%	2.0%
ID's by D. McGuire								

MACROINVERTEBRATE DATA

BLACKFOOT RIVER between Landers Fork & Lincoln STAT. 4 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						0%	10	
Optioservus spp.	16	5	4	3	28	0%	7.0	6.1
Zaitzevia sp.	1	1	5	4	11	0%	2.8	2.1
DIPTERA						85%	4356	
unassociated midge pupa	2	22	4	0	28	0%	7.0	10.1
Pagastia sp	32	15	5	5	57	0%	14.3	12.7
Cardiocladius spp.	14	2	1	0	17	0%	4.3	6.6
Cricotopus spp.	80	52	48	26	206	1%	51.5	22.2
Eukiefferiella spp.	96	30	16	20	162	1%	40.5	37.5
Orthocladius spp.	1	18	12	6	37	0%	9.3	7.4
Paraphaenocladius sp.	8	12	1	4	25	0%	6.3	4.8
Tvetenia sp.	160	22	34	26	242	1%	60.5	66.5
Micropsectra spp.	264	106	132	366	868	4%	217.0	121.0
Hexatoma sp.	4	2	3	7	16	0%	4.0	2.2
Pericoma sp.	0	0	1	0	1	0%	0.3	0.5
Ceratopogoninae	0	0	0	1	1	0%	0.3	0.5
Simulium sp.	9000	3300	2000	1400	15700	76%	3925.0	3475
Chelifera sp.	1	1	0	0	2	0%	0.5	0.6
Clinocera sp.	16	4	24	16	60	0%	15.0	8.2
EPHEMEROPTERA						14%	707	
Baetis insignificans	4	22	0	0	26	0%	6.5	10.5
Baetis tricaudatus	672	402	524	482	2080	10%	520.0	113.3
Serratella tibialis	24	44	14	20	102	0%	25.5	13.0
Drunella coloradensis	0	0	0	2	2	0%	0.5	1.0
Drunella doddsi	12	66	34	36	148	1%	37.0	22.2
Cinygmula	32	30	48	70	180	1%	45.0	18.5
Epeorus albertae	32	102	30	32	196	1%	49.0	35.3
Rhithrogena sp.	8	68	14	2	92	0%	23.0	30.4
Paraleptophlebia sp.	0	0	0	2	2	0%	0.5	1.0
PLECOPTERA						1%	41	
Perlidae (small)	0	0	2	2	4	0%	1.0	1.2
Claassenia sabulosa	1	0	0	0	1	0%	0.3	0.5
Hesperoperla pacifica	16	0	8	0	24	0%	6.0	7.7
Zapada cinctipes	16	0	4	0	20	0%	5.0	7.6
Perlodidae(small)	3	20	4	8	35	0%	8.8	7.8
Cultus sp.	0	0	0	5	5	0%	1.3	2.5
Pteronarcella badia	9	16	0	0	25	0%	6.3	7.8
Chloroperlidae	15	20	8	7	50	0%	12.5	6.1

MACROINVERTEBRATE DATA

BLACKFOOT RIVER between Landers Fork & Lincoln STAT. 4 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						1%	40	
Arctopsyche grandis	16	5	9	6	36	0%	9.0	5.0
H. (Ceratopsyche) spp.?	18	1	4	4	27	0%	6.8	7.6
Neophylx sp.	0	0	0	1	1	0%	0.3	0.5
Brachycentrus occidentalis	1	12	5	10	28	0%	7.0	5.0
Rhyacophila angelita sp.	19	8	7	5	39	0%	9.8	6.3
Rhyacophila brunnea gp.	1	0	1	1	3	0%	0.8	0.5
Rhyacophila Iranda gp.	8	1	0	0	9	0%	2.3	3.9
Agapetus sp.	1	8	1	5	15	0%	3.8	3.4
Glossosoma sp.	1	0	0	0	1	0%	0.3	0.5
MOLLUSCA								
Physa sp.	0	0	0	1	1	0%	0	0.5
OTHER								
Turbellaria	0	0	2	0	2	0%	0.5	1.0
TOTAL ORGANISMS	10604	4417	3009	2585	20615		5154	3717
TAXA RICHNESS	36	31	33	33	45		33	2.1
SHAN. DIVERSITY	1.08	1.71	1.87	2.24	1.56		1.73	0.48
BIOTIC INDEX	5.78	5.40	5.37	5.34	5.59		5.47	0.21
EPT RICHNESS	21	16	17	19	25		18	2.2
EPT / CHIR.	1.38	2.96	2.83	1.54	1.92		2.2	0.8
% R.A. DOMINANT	85%	75%	66%	54%	76%		70%	13.0%
% R.A. FILTERERS	85%	75%	67%	55%	77%		71%	12.8%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Dalton Mtn. Rd. Br. - STATION 5 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						1%	26	
Optioservus spp.	3	40	11	12	66	1%	16.5	16.2
Clepelmis sp.	1	0	0	0	1	0%	0.3	0.5
Zaitzevia parvula	0	4	7	1	12	0%	3.0	3.2
Brychius sp.	0	2	14	8	24	0%	6.0	6.3
DIPTERA						76%	1578	
Thienemannimyia gp.	0	0	0	1	1	0%	0.3	0.5
Pagastia sp	7	1	25	9	42	1%	10.5	10.2
Cardiocladius spp.	4	0	1	2	7	0%	1.8	1.7
Cricotopus spp.	2	11	32	5	50	1%	12.5	13.5
Eukiefferiella spp.	6	0	12	4	22	0%	5.5	5.0
Orthocladius spp.	4	0	0	0	4	0%	1.0	2.0
Paraphaenocladius sp.	1	0	0	0	1	0%	0.3	0.5
Rheocricotopus sp.	0	0	1	0	1	0%	0.3	0.5
Tvetenia sp.	10	4	18	16	48	1%	12.0	6.3
Micropsectra spp.	1	5	7	1	14	0%	3.5	3.0
Antocha sp.	0	0	3	4	7	0%	1.8	2.1
Hexatoma sp.	1	0	0	3	4	0%	1.0	1.4
Limonia (?) sp.	0	0	1	0	1	0%	0.3	0.5
Glutops sp.	0	7	0	1	8	0%	2.0	3.4
Pericoma sp.	0	0	1	0	1	0%	0.3	0.5
Atherix pachypus	1	1	3	23	28	0%	7.0	10.7
Simulium sp.	2800	1200	262	1800	6062	73%	1515.5	1065
Chelifera sp.	0	3	3	2	8	0%	2.0	1.4
Clinocera sp.	1	0	0	0	1	0%	0.3	0.5
EPHEMEROPTERA						13%	274	
Baetis insignificans	14	8	5	0	27	0%	6.8	5.9
Baetis tricaudatus	248	177	262	88	775	9%	193.8	79.7
Serratella tibialis	9	36	18	21	84	1%	21.0	11.2
Drunella grandis	3	12	7	0	22	0%	5.5	5.2
Rhithrogena sp.	79	40	46	20	185	2%	46.3	24.5
Tricorythodes minutus	1	0	0	0	1	0%	0.3	0.5
PLECOPTERA						6%	119	
Claussenia sabulosa	1	3	1	3	8	0%	2.0	1.2
Hesperoperla pacifica	4	0	3	4	11	0%	2.8	1.9
Zapada cinctipes	3	0	2	0	5	0%	1.3	1.5
Skwala parallela	0	0	1	2	3	0%	0.8	1.0
Pteronarcella badia	9	6	5	9	29	0%	7.3	2.1
Pteronarcys californica	0	0	0	1	1	0%	0.3	0.5
Chloroperlinae	103	104	98	112	417	5%	104.3	5.8

MACROINVERTEBRATE DATA								
BLACKFOOT RIVER at Dalton Mtn. Rd. Br. - STATION 5 - 8/10/88								
Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						4%	92	
Arctopsyche grandis	46	61	15	75	197	2%	49.3	25.7
Cheumatopsyche spp.	0	0	0	2	2	0%	0.5	1.0
H. (Hydropsyche) spp.?	14	52	18	13	97	1%	24.3	18.6
Neophylx sp.	0	0	0	1	1	0%	0.3	0.5
Hydroptila spp.	0	4	2	0	6	0%	1.5	1.9
Ochrotrichia sp	2	0	2	0	4	0%	1.0	1.2
Brachycentrus americanus	5	7	4	9	25	0%	6.3	2.2
Brachycentrus occidentalis	1	4	8	3	16	0%	4.0	2.9
Rhyacophila brunnea gp.	0	3	0	1	4	0%	1.0	1.4
Cymellus sp.	0	0	0	1	1	0%	0.3	0.5
Glossosoma sp.	3	4	2	1	10	0%	2.5	1.3
ANNELIDA						0%	1	
Lumbricidae	0	3	0	0	3	0%	0.8	1.5
TOTAL ORGANISMS	3387	1802	900	2258	8347		2087	1034
TAXA RICHNESS	31	27	34	34	48		32	3.3
SHAN. DIVERSITY	1.17	2.05	3.21	1.46	1.80		1.97	0.90
BIOTIC INDEX	5.44	4.99	4.06	5.29	5.15		4.94	0.62
EPT RICHNESS	17	15	18	18	24		17	1.4
EPT / CHIR.	15.57	24.81	5.20	9.63	10.16		13.8	8.5
% R.A. DOMINANT	83%	67%	29%	80%	73%		65%	24.6%
% R.A. FILTERERS	85%	73%	34%	84%	77%		69%	23.9%
ID's by D. McGuire								

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Nevada-Ogden Rd. Br. - STATION 6 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						7%	45	
Optioservus spp.	48	26	22	46	142	5%	35.5	13.4
Zaitzevia parvula	7	2	12	1	22	1%	5.5	5.1
Narpus concolor	10	4	0	0	14	1%	3.5	4.7
Brychius sp.	2	1	0	0	3	0%	0.8	1.0
DIPTERA						22%	143	
unassociated midge pupa	0	0	2	0	2	0%	0.5	1.0
Pagastia sp	1	0	0	1	2	0%	0.5	0.6
Potthastia gaeddi gp.	1	0	0	0	1	0%	0.3	0.5
Brillia sp.	1	0	0	0	1	0%	0.3	0.5
Cricotopus spp.	3	0	0	11	14	1%	3.5	5.2
Eukiefferiella spp.	1	2	3	1	7	0%	1.8	1.0
Thienemanniella sp.	2	1	0	0	3	0%	0.8	1.0
Synorthocladius sp.	2	0	0	1	3	0%	0.8	1.0
Tvetenia sp.	5	1	2	9	17	1%	4.3	3.6
Paraphaenocladius sp.	1	0	0	0	1	0%	0.3	0.5
Rheotanytarsus sp.	4	1	0	2	7	0%	1.8	1.7
Micropsectra spp.	20	38	140	157	355	14%	88.8	69.7
Antocha sp.	0	0	1	3	4	0%	1.0	1.4
Hexatoma sp.	23	10	2	4	39	1%	9.8	9.5
Atherix pachypus	3	2	0	2	7	0%	1.8	1.3
Simulium spp.	64	18	9	6	97	4%	24.3	27.0
Chelifera sp.	7	3	0	2	12	0%	3.0	2.9
Glutops sp.	0	0	1	0	1	0%	0.3	0.5
EPHEMEROPTERA						55%	362	
Ameletus sp.	0	1	0	0	1	0%	0.3	0.5
Baetis insignificans	21	12	36	37	106	4%	26.5	12.1
Baetis tricaudatus	28	18	34	85	165	6%	41.3	29.9
Attenella margarita	0	1	0	0	1	0%	0.3	0.5
Serratella tibialis	10	7	7	13	37	1%	9.3	2.9
Drunella grandis	12	8	0	15	35	1%	8.8	6.5
Timpango hecuba	2	0	0	0	2	0%	0.5	1.0
Heptageniidae	0	4	0	0	4	0%	1.0	2.0
Rhithrogena sp.	139	237	293	408	1077	41%	269.3	112.3
Paraleptophlebia sp.	1	4	10	4	19	1%	4.8	3.8
PLECOPTERA						12%	78	
Perlidae	1	2	3	0	6	0%	1.5	1.3
Claassenia sabulosa	1	2	1	3	7	0%	1.8	1.0
Hesperoperla pacifica	0	1	3	3	7	0%	1.8	1.5
Zapada cinctipes	2	1	1	6	10	0%	2.5	2.4
Perlodidae	1	4	0	2	7	0%	1.8	1.7
Skwala sp.	0	0	1	6	7	0%	1.8	2.9
Pteronarcella badia	1	1	5	0	7	0%	1.8	2.2
Chloroperlinae	41	78	71	69	259	10%	64.8	16.3

MACROINVERTEBRATE DATA								
BLACKFOOT RIVER at Nevada-Ogden Rd. Br. - STATION 6 - 8/10/88								
Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						4%	24	
Arctopsyche grandis	2	1	0	0	3	0%	0.8	1.0
H. (Hydropsyche) spp.?	2	8	0	2	12	0%	3.0	3.5
Limnephilidae	9	19	5	18	51	2%	12.8	6.8
Apatania sp.	4	4	0	0	8	0%	2.0	2.3
Hydroptila spp.	3	0	0	0	3	0%	0.8	1.5
Ceraclea sp.	0	1	1	0	2	0%	0.5	0.6
Brachycentrus occidentalis	3	2	1	5	11	0%	2.8	1.7
Rhyacophila sp.	0	2	1	0	3	0%	0.8	1.0
Glossosoma sp.	1	0	0	0	1	0%	0.3	0.5
ANNELIDA						0%	2	
Lumbricidae	1	2	0	0	3	0%	0.8	1.0
Tubificidae	0	0	0	3	3	0%	0.8	1.5
TOTAL ORGANISMS	490	529	667	925	2611		653	197
TAXA RICHNESS	40	37	26	30	51		33	6.4
SHAN. DIVERSITY	3.80	3.15	2.69	2.88	3.25		3.13	0.48
BIOTIC INDEX	2.87	1.82	2.52	2.50	2.44		2.43	0.44
EPT RICHNESS	20	23	16	15	27		19	3.7
EPT / CHIR.	6.93	9.72	3.22	3.71	4.48		5.9	3.0
% R.A. DOMINANT	28%	45%	44%	44%	41%		40%	8.0%
% R.A. FILTERERS	17%	10%	2%	3%	7%		8%	6.9%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Helmville Bridge - STATION 7 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						8%	257	
Optioservus spp.	130	188	208	66	592	5%	148.0	63.9
Zaitzevia parvula	50	120	246	20	436	4%	109.0	100.5
DIPTERA						28%	845	
unassociated midge pupa	0	6	0	0	6	0%	1.5	3.0
Thienemannimyia gp.	1	34	52	42	129	1%	32.3	22.1
Pentaneura sp.	1	0	0	6	7	0%	1.8	2.9
Cardiocladius spp.	0	0	6	0	6	0%	1.5	3.0
Cricotopus spp.	70	206	74	102	452	4%	113.0	63.6
Eukiefferiella spp.	4	28	16	0	48	0%	12.0	12.6
Orthocladius spp.	4	1	6	4	15	0%	3.8	2.1
Paraphaenocladius sp.	1	6	42	16	65	1%	16.3	18.3
Tvetenia sp.	44	100	158	18	320	3%	80.0	62.2
Polypedilum spp.	0	8	32	8	48	0%	12.0	13.9
Microtendipes sp	0	1	0	22	23	0%	5.8	10.8
Phaenopsectra sp	0	0	8	4	12	0%	3.0	3.8
Rheotanytarsus sp.	0	2	0	0	2	0%	0.5	1.0
Micropsectra spp.	6	8	40	20	74	1%	18.5	15.6
Antocha sp.	10	1	1	0	12	0%	3.0	4.7
Hexatoma sp.	12	0	13	8	33	0%	8.3	5.9
Atherix pachypus	1	1	0	1	3	0%	0.8	0.5
Simulium spp.	132	172	1700	120	2124	17%	531.0	779.7
Protanyderus sp.	1	0	0	0	1	0%	0.3	0.5
EPHEMEROPTERA						9%	264	
Baetis tricaudatus	58	92	148	90	388	3%	97.0	37.4
Psuedocloeon sp.	0	24	136	58	218	2%	54.5	59.3
Attenella margarita	0	12	38	30	80	1%	20.0	17.2
Serratella tibialis	0	2	8	8	18	0%	4.5	4.1
Drunella doddsi	2	0	0	0	2	0%	0.5	1.0
Heptageniidae	1	0	16	28	45	0%	11.3	13.4
Rhithrogena sp.	16	20	32	8	76	1%	19.0	10.0
Paraleptophlebia sp.	1	4	30	4	39	0%	9.8	13.6
Tricorythodes minutus	0	44	40	106	190	2%	47.5	43.8
HEMIPTERA								
Sigara alternata	0	1	0	0	1	0%	0.3	0.5
ODONATA								
Ophiogomphus sp.	0	1	6	0	7	0%	1.8	2.9

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Helmville Bridge - STATION 7 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
PLECOPTERA						1%	25	
Calineuria californica	4	4	6	0	14	0%	3.5	2.5
Claassenia sabulosa	0	0	2	0	2	0%	0.5	1.0
Hesperoperla pacifica	8	16	8	15	47	0%	11.8	4.3
Isogenoides sp.	1	0	1	0	2	0%	0.5	0.6
Pteronarcella badia	1	3	1	1	6	0%	1.5	1.0
Pteronarcys californica	3	6	14	4	27	0%	6.8	5.0
Chloroperlinae	0	0	0	2	2	0%	0.5	1.0
TRICHOPTERA						54%	1650	
Arctopsyche grandis	2	0	0	0	2	0%	0.5	1.0
Cheumatopsyche spp.	116	196	576	98	986	8%	246.5	223.8
H. (Hydropsyche) spp.?	596	736	3284	556	5172	42%	1293.0	#####
H. (Ceratopsyche) spp.?	49	14	76	30	169	1%	42.3	26.7
Hydroptila spp.	0	28	14	16	58	0%	14.5	11.5
Oecetis sp.	1	8	30	26	65	1%	16.3	14.0
Psychomyia flavida	1	0	0	1	2	0%	0.5	0.6
Brachycentrus occidentalis	16	10	36	50	112	1%	28.0	18.4
Culoptila sp	0	0	0	3	3	0%	0.8	1.5
Helicopsyche sp	0	3	0	29	32	0%	8.0	14.1
ANNELIDA						0%	5	
Tubificidae	0	4	0	16	20	0%	5.0	7.6
MOLLUSCA						0%	1	
Gyraulus sp.	0	2	0	0	2	0%	0.5	1.0
TOTAL ORGANISMS	1343	2112	7104	1636	12195		3049	2722
TAXA RICHNESS	32	38	36	37	51		36	2.6
SHAN. DIVERSITY	2.96	3.42	2.67	3.82	3.14		3.22	0.51
BIOTIC INDEX	4.94	5.12	5.12	4.88	5.07		5.02	0.12
EPT RICHNESS	17	18	20	21	26		19	1.8
EPT / CHIR.	6.69	3.06	10.36	4.81	6.43		6.2	3.1
% R.A. DOMINANT	44%	35%	46%	34%	42%		40%	6.3%
% R.A. FILTERERS	68%	53%	80%	52%	70%		63%	13.1%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER above Monture Cr. - STATION 8 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						12%	220	
Optioservus spp.	57	225	76	128	486	7%	121.5	75.2
Zaitzevia parvula	85	106	129	72	392	5%	98.0	25.0
DIPTERA						36%	653	
unassociated midge pupa	9	2	4	19	34	0%	8.5	7.6
Thienemannimyia gp.	2	9	0	0	11	0%	2.8	4.3
Pagastia sp	1	5	0	1	7	0%	1.8	2.2
Potthastia gaeddi gp.	3	0	0	1	4	0%	1.0	1.4
Cardiocladius spp.	1	0	4	7	12	0%	3.0	3.2
Cricotopus spp.	16	10	8	16	50	1%	12.5	4.1
Eukiefferiella spp.	1	31	9	4	45	1%	11.3	13.6
Thienemanniella sp.	1	0	0	0	1	0%	0.3	0.5
Synorthocladius sp.	0	1	4	0	5	0%	1.3	1.9
Tvetenia sp.	3	58	27	1	89	1%	22.3	26.6
Polypedilum spp.	0	5	0	0	5	0%	1.3	2.5
Microtendipes sp	0	7	0	0	7	0%	1.8	3.5
Rheotanytarsus sp.	4	15	8	0	27	0%	6.8	6.4
Micropsectra spp.	124	838	484	304	1750	24%	437.5	304.8
Antocha sp.	3	3	4	24	34	0%	8.5	10.3
Hexatoma sp.	1	12	8	1	22	0%	5.5	5.4
Atherix pachypus	1	9	8	5	23	0%	5.8	3.6
Simulium spp.	12	325	32	80	449	6%	112.3	144.7
Chelifera sp.	20	3	4	8	35	0%	8.8	7.8
EPHEMEROPTERA						23%	411	
Baetis insignificans	4	9	8	4	25	0%	6.3	2.6
Baetis tricaudatus	64	458	224	544	1290	18%	322.5	219.0
Serratella tibialis	16	19	0	4	39	1%	9.8	9.2
Drunella doddsi	0	0	23	17	40	1%	10.0	11.8
Drunella grandis	0	15	0	0	15	0%	3.8	7.5
Rhithrogena sp.	8	49	64	72	193	3%	48.3	28.5
Tricorythodes minutus	16	14	4	8	42	1%	10.5	5.5
PLECOPTERA						5%	82	
Perlidae	0	6	20	12	38	1%	9.5	8.5
Claassenia sabulosa	1	0	1	2	4	0%	1.0	0.8
Hesperoperla pacifica	4	0	1	3	8	0%	2.0	1.8
Perlodidae	0	0	1	0	1	0%	0.3	0.5
Pteronarcella badia	0	8	0	11	19	0%	4.8	5.6
Pteronarcys californica	2	33	13	52	100	1%	25.0	22.1
Chloroperlinae	25	50	42	42	159	2%	39.8	10.5

MACROINVERTEBRATE DATA

BLACKFOOT RIVER above Monture Cr. - STATION 8 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						25%	454	
Arctopsyche grandis	6	13	20	11	50	1%	12.5	5.8
Cheumatopsyche spp.	7	3	160	41	211	3%	52.8	73.5
Hydropsyche cockerelli	26	66	62	169	323	4%	80.8	61.5
H. (Ceratopsyche) spp.?	56	253	312	408	1029	14%	257.3	148.6
Limnephilidae	12	4	12	8	36	0%	9.0	3.8
Hydroptila spp.	0	1	0	0	1	0%	0.3	0.5
Oecetis sp.	3	0	0	1	4	0%	1.0	1.4
Psychomyia flavida	12	0	4	20	36	0%	9.0	8.9
Brachycentrus occidentalis	28	38	32	11	109	1%	27.3	11.6
Rhyacophila angelita sp.	0	0	2	0	2	0%	0.5	1.0
Helicopsyche sp	0	3	0	0	3	0%	0.8	1.5
Culoptila sp	12	0	0	0	12	0%	3.0	6.0
ANNELIDA								
Tubificidae	4	1	8	0	13	0%	3.3	3.6
MOLLUSCA						0%	1	
Physa sp.	1	0	0	0	1	0%	0.3	0.5
Sphaeriidae	0	0	1	0	1	0%	0.3	0.5
TOTAL ORGANISMS	651	2707	1823	2111	7292		1823	864
TAXA RICHNESS	38	37	36	35	50		37	1.3
SHAN. DIVERSITY	4.10	3.36	3.58	3.48	3.71		3.63	0.33
BIOTIC INDEX	4.61	5.23	4.88	4.52	4.88		4.81	0.32
EPT RICHNESS	18	18	19	20	25		19	1.0
EPT / CHIR.	1.83	1.06	1.80	4.05	1.83		2.2	1.3
% R.A. DOMINANT	19%	31%	27%	26%	24%		26%	4.9%
% R.A. FILTERERS	23%	26%	35%	34%	30%		29%	6.1%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER below Scotty Brown Bridge - STATION 9 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						6%	209	
Optioservus spp.	126	76	156	168	526	4%	131.5	41.0
Zaitzevia parvula	49	31	190	40	310	2%	77.5	75.4
DIPTERA						54%	1927	
unassociated midge pupa	7	3	36	7	53	0%	13.3	15.3
Thienemannimyia gp.	8	0	0	22	30	0%	7.5	10.4
Pagastia sp	0	4	0	2	6	0%	1.5	1.9
Potthastia gaeddi gp.	1	0	12	0	13	0%	3.3	5.9
Cardiocladius spp.	16	2	0	2	20	0%	5.0	7.4
Cricotopus spp.	60	18	72	128	278	2%	69.5	45.4
Eukiefferiella spp.	40	9	24	8	81	1%	20.3	15.1
Orthocladius spp.	1	0	0	0	1	0%	0.3	0.5
Tvetenia sp.	5	10	36	24	75	1%	18.8	14.0
Polypedilum spp.	12	1	12	0	25	0%	6.3	6.7
Microtendipes sp	8	1	0	0	9	0%	2.3	3.9
Rheotanytarsus sp.	0	3	24	0	27	0%	6.8	11.6
Micropsectra spp.	684	203	720	288	1895	13%	473.8	266.2
Antocha sp.	1	2	48	2	53	0%	13.3	23.2
Hexatoma sp.	7	2	1	2	12	0%	3.0	2.7
Atherix pachypus	2	0	12	8	22	0%	5.5	5.5
Simulium sp.	4	0	4600	504	5108	36%	1277.0	2228
EPHEMEROPTERA						15%	552	
Baetis insignificans	8	9	48	24	89	1%	22.3	18.7
Baetis tricaudatus	384	245	468	576	1673	12%	418.3	139.7
Serratella tibialis	11	26	132	32	201	1%	50.3	55.2
Drunella doddsi	27	16	0	32	75	1%	18.8	14.2
Drunella grandis	0	0	24	0	24	0%	6.0	12.0
Epeorus albertae	4	0	0	0	4	0%	1.0	2.0
Rhithrogena sp.	40	25	48	28	141	1%	35.3	10.7
PLECOPTERA						3%	109	
Calineuria californica	2	7	36	4	49	0%	12.3	16.0
Claassenia sabulosa	2	0	0	2	4	0%	1.0	1.2
Hesperoperla pacifica	5	2	3	1	11	0%	2.8	1.7
Skwala sp.	0	2	0	0	2	0%	0.5	1.0
Pteronarcys californica	5	13	29	7	54	0%	13.5	10.9
Chloroperlinae	112	44	72	86	314	2%	78.5	28.3

MACROINVERTEBRATE DATA

BLACKFOOT RIVER below Scotty Brown Bridge - STATION 9 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						22%	779	
Arctopsyche grandis	10	5	21	10	46	0%	11.5	6.8
Cheumatopsyche spp.	12	8	0	0	20	0%	5.0	6.0
Hydropsyche occidentalis	0	0	0	14	14	0%	3.5	7.0
Hydropsyche cockerelli	152	76	168	29	425	3%	106.3	65.3
H. (Ceratopsyche) spp.?	616	172	1068	592	2448	17%	612.0	366.0
Micrasema sp.	0	0	60	8	68	0%	17.0	28.9
Hydroptila spp.	0	1	0	8	9	0%	2.3	3.9
Psychomyia flavida	5	2	12	0	19	0%	4.8	5.3
Micrasema sp.	0	0	38	1	39	0%	9.8	18.8
Brachycentrus occidentalis	5	2	21	1	29	0%	7.3	9.3
ANNELIDA								
Lumbriculidae	0	1	0	24	25	0%	6.3	11.8
Tubificidae	0	1	1	8	10	0%	2.5	3.7
MOLLUSCA								
Gyraulus sp.	0	0	1	0	1	0%	0.3	0.5
Sphaeriidae	0	0	1	0	1	0%	0.3	0.5
TOTAL ORGANISMS	2431	1022	8194	2692	14339		3585	3159
TAXA RICHNESS	34	33	33	34	46		34	0.6
SHAN. DIVERSITY	3.11	3.42	2.49	3.30	3.14		3.08	0.41
BIOTIC INDEX	5.12	4.65	5.47	5.03	5.27		5.07	0.34
EPT RICHNESS	17	17	16	18	23		17	0.8
EPT / CHIR.	1.66	2.58	2.40	3.02	2.29		2.4	0.6
% R.A. DOMINANT	28%	24%	56%	22%	36%		33%	15.9%
% R.A. FILTERERS	33%	26%	72%	43%	56%		43%	20.2%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Sperry Grade Access - STATION 10 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						9%	178	
Optioservus spp.	28	133	65	138	364	5%	91.0	53.6
Zaitzevia parvula	16	60	81	190	347	4%	86.8	74.0
DIPTERA						32%	640	
unassociated midge pupa	3	12	5	6	26	0%	6.5	3.9
Thienemannimyia gp.	0	7	4	0	11	0%	2.8	3.4
Pentaneura sp.	0	0	0	2	2	0%	0.5	1.0
Cardiocladius spp.	3	4	9	0	16	0%	4.0	3.7
Cricotopus spp.	3	8	28	37	76	1%	19.0	16.1
Eukiefferiella spp.	4	20	37	36	97	1%	24.3	15.6
Orthocladius spp.	0	0	3	6	9	0%	2.3	2.9
Paraphaenocladius sp.	0	3	1	6	10	0%	2.5	2.6
Tvetenia sp.	6	28	8	20	62	1%	15.5	10.4
Polypedilum spp.	3	7	5	6	21	0%	5.3	1.7
Robackia sp.	1	0	0	0	1	0%	0.3	0.5
Cladotanytarsus sp.	1	0	0	0	1	0%	0.3	0.5
Rheotanytarsus sp.	0	0	1	0	1	0%	0.3	0.5
Micropsectra spp.	110	684	528	538	1860	23%	465.0	247.2
Antocha sp.	0	6	22	26	54	1%	13.5	12.5
Hexatoma sp.	11	7	23	5	46	1%	11.5	8.1
Atherix pachypus	1	23	9	15	48	1%	12.0	9.3
Simulium sp.	0	36	108	74	218	3%	54.5	46.7
EPHEMEROPTERA						17%	349	
Baetis insignificans	14	24	8	30	76	1%	19.0	9.9
Baetis tricaudatus	108	238	156	380	882	11%	220.5	119.1
Attenella margarita	0	1	0	0	1	0%	0.3	0.5
Serratella tibialis	20	33	13	24	90	1%	22.5	8.3
Drunella doddsi	13	32	25	54	124	2%	31.0	17.2
Drunella grandis	0	0	0	6	6	0%	1.5	3.0
Rhithrogena sp.	24	112	37	30	203	3%	50.8	41.2
Tricorythodes minutus	0	0	8	6	14	0%	3.5	4.1
PLECOPTERA						3%	54	
Calineuria californica	3	6	4	0	13	0%	3.3	2.5
Claassenia sabulosa	2	3	4	11	11	0%	5.0	4.1
Hesperoperla pacifica	1	0	2	3	6	0%	1.5	1.3
Perlodidae	0	3	0	0	3	0%	0.8	1.5
Pteronarcys californica	2	7	1	25	35	0%	8.8	11.1
Chloroperlinae	11	28	40	60	139	2%	34.8	20.6

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Sperry Grade Access - STATION 10 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						39%	775	
Arctopsyche grandis	6	9	14	40	69	1%	17.3	15.5
Cheumatopsyche spp.	39	124	156	72	391	5%	97.8	52.3
Hydropsyche occidentalis	24	36	31	104	195	2%	48.8	37.2
Hydropsyche cockerelli	71	120	140	384	715	9%	178.8	139.9
H. (Ceratopsyche) spp.?	232	368	228	834	1662	21%	415.5	286.5
Dicosmoecus sp.	0	0	0	1	1	0%	0.3	0.5
Lepidostoma sp.	0	0	0	6	6	0%	1.5	3.0
Ceraclea sp.	1	0	0	0	1	0%	0.3	0.5
Psychomyia flavida	0	0	5	12	17	0%	4.3	5.7
Brachycentrus occidentalis	4	4	0	17	25	0%	6.3	7.4
Rhyacophila coloradensis	0	0	0	1	1	0%	0.3	0.5
Rhyacophila sp.	0	12	4	1	17	0%	4.3	5.4
ANNELIDA								
Enchytraedae	6	0	16	0	22	0%	5.5	7.5
TOTAL ORGANISMS	771	2198	1829	3206	7995		2001	1006
TAXA RICHNESS	31	33	36	37	47		34	2.8
SHAN. DIVERSITY	3.48	3.48	3.71	3.58	3.68		3.56	0.11
BIOTIC INDEX	4.60	4.99	5.14	4.76	4.90		4.87	0.24
EPT RICHNESS	17	18	18	22	26		19	2.2
EPT / CHIR.	4.29	1.50	1.39	3.20	2.14		2.6	1.4
% R.A. DOMINANT	30%	31%	29%	26%	23%		29%	2.2%
% R.A. FILTERERS	49%	32%	37%	48%	41%		41%	8.3%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER atRoundup Bar Bridge - STATION11 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						9%	152	
Optioservus spp.	69	90	80	76	315	5%	78.8	8.8
Zaitzevia sp.	62	87	64	72	285	4%	71.3	11.4
Cleptelmis ornata	1	6	0	0	7	0%	1.8	2.9
DIPTERA						37%	599	
unassociated midge pupa	2	4	4	24	34	1%	8.5	10.4
Thienemannimyia gp.	6	1	8	16	31	0%	7.8	6.2
Pagastia sp	1	0	0	4	5	0%	1.3	1.9
Potthastia gaeddi gp.	3	3	0	104	110	2%	27.5	51.0
Cardiocladius spp.	0	1	28	12	41	1%	10.3	13.0
Cricotopus spp.	2	9	4	144	159	2%	39.8	69.6
Eukiefferiella spp.	1	3	36	12	52	1%	13.0	16.1
Orthocladius spp.	0	0	0	8	8	0%	2.0	4.0
Paraphaenocladius sp.	6	0	12	0	18	0%	4.5	5.7
Tvetenia sp.	11	9	12	12	44	1%	11.0	1.4
Polypedilum spp.	3	2	0	4	9	0%	2.3	1.7
Microtendipes sp	5	1	0	0	6	0%	1.5	2.4
Rheotanytarsus sp.	1	0	4	0	5	0%	1.3	1.9
Micropsectra spp.	152	65	116	116	449	7%	112.3	35.8
Antocha sp.	16	1	0	20	37	1%	9.3	10.2
Hexatoma sp.	9	1	0	0	10	0%	2.5	4.4
Atherix pachypus	13	0	9	24	46	1%	11.5	9.9
Simulium sp.	5	30	1236	56	1327	21%	331.8	603.2
Chelifera sp.	0	0	0	4	4	0%	1.0	2.0
EPHEMEROPTERA						14%	231	
Baetis insignificans	6	7	8	4	25	0%	6.3	1.7
Baetis tricaudatus	72	121	349	128	670	10%	167.5	123.5
Attenella margarita	3	0	0	1	4	0%	1.0	1.4
Serratella tibialis	8	2	0	8	18	0%	4.5	4.1
Drunella doddsi	3	5	16	12	36	1%	9.0	6.1
Drunella grandis	2	1	0	4	7	0%	1.8	1.7
Epeorus sp.	0	2	0	0	2	0%	0.5	1.0
Rhithrogena sp.	22	25	72	40	159	2%	39.8	22.9
Tricorythodes minutus	2	0	0	0	2	0%	0.5	1.0
LEPIDOPTERA								
Petrophila sp.	0	1	0	36	37	1%	9.3	17.8
PLECOPTERA						5%	73	
Calineuria californica	9	7	12	12	40	1%	10.0	2.4
Claassenia sabulosa	7	3	2	1	13	0%	3.3	2.6
Hesperoperla pacifica	0	0	4	0	4	0%	1.0	2.0
Perlodidae	2	4	0	0	6	0%	1.5	1.9
Skwala parallela	3	0	0	1	4	0%	1.0	1.4
Pteronarcys californica	46	52	37	8	143	2%	35.8	19.5
Chloroperlinae	19	20	24	20	83	1%	20.8	2.2

MACROINVERTEBRATE DATA

BLACKFOOT RIVER atRoundup Bar Bridge - STATION11 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
TRICHOPTERA						34%	544	
Arctopsyche grandis	7	17	18	4	46	1%	11.5	7.0
Cheumatopsyche spp.	105	165	212	240	722	11%	180.5	59.1
Hydropsyche occidentalis	25	11	8	20	64	1%	16.0	7.9
Hydropsyche cockerelli	37	53	176	112	378	6%	94.5	63.2
H. (Ceratopsyche) spp.?	29	110	240	284	663	10%	165.8	117.3
Lepidostoma sp.	1	0	4	8	13	0%	3.3	3.6
Oecetis sp.	0	0	0	4	4	0%	1.0	2.0
Psychomyia flavida	4	3	4	28	39	1%	9.8	12.2
Brachycentrus occidentalis	61	40	21	108	230	4%	57.5	37.4
Rhyacophila angelita sp.	1	0	0	0	1	0%	0.3	0.5
Rhyacophila coloradensis	1	1	10	0	12	0%	3.0	4.7
Helicopsyche sp	1	1	0	0	2	0%	0.5	0.6
Dicosmoecus sp.	2	0	0	0	2	0%	0.5	1.0
ANNELIDA						0%	8.	
Lumbricolidae	0	0	15	4	19	0%	4.8	7.1
Tubificidae	1	0	8	4	13	0%	3.3	3.6
MOLLUSCA						0%	1.	
Physa sp.	1	0	0	0	1	0%	0.3	0.5
Ferrissia sp.	1	0	0	0	1	0%	0.3	0.5
OTHER								
Turbellaria	3	0	0	0	3	0%	0.8	1.5
TOTAL ORGANISMS	852	964	2853	1799	6468		1617	926
TAXA RICHNESS	49	38	33	41	57		40	6.7
SHAN. DIVERSITY	4.25	3.93	3.11	4.24	4.09		3.88	0.53
BIOTIC INDEX	4.21	4.25	5.05	4.45	4.65		4.49	0.39
EPT RICHNESS	26	21	18	21	29		22	3.3
EPT / CHIR.	2.48	6.63	5.43	2.30	3.49		4.2	2.2
% R.A. DOMINANT	18%	17%	43%	16%	21%		24%	13.2%
% R.A. FILTERERS	32%	44%	67%	46%	53%		47%	14.7%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Ninemile Prairie - STATION 12 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						9%	86	
Optioservus spp.	14	30	21	16	81	2%	20.3	7.1
Zaitzevia parvula	33	77	86	68	264	7%	66.0	23.2
DIPTERA						19%	183	
unassociated midge pupa	4	6	3	7	20	1%	5.0	1.8
Thienemannimyia gp.	6	6	1	2	15	0%	3.8	2.6
Potthastia gaeddi gp.	19	3	0	0	22	1%	5.5	9.1
Cardiocladius spp.	6	0	0	1	7	0%	1.8	2.9
Corynoneura sp	0	1	0	0	1	0%	0.3	0.5
Cricotopus spp.	37	22	9	25	93	2%	23.3	11.5
Eukiefferiella spp.	18	15	6	24	63	2%	15.8	7.5
Orthocladius spp.	2	0	0	2	4	0%	1.0	1.2
Paraphaenocladius sp.	4	2	0	1	7	0%	1.8	1.7
Synorthocladius sp.	2	6	2	5	15	0%	3.8	2.1
Tvetenia sp.	3	2	0	3	8	0%	2.0	1.4
Polypedilum spp.	5	7	7	10	29	1%	7.3	2.1
Microtendipes sp	0	2	0	0	2	0%	0.5	1.0
Phaenopsectra sp	0	0	1	0	1	0%	0.3	0.5
Rheotanytarsus sp.	0	1	2	1	4	0%	1.0	0.8
Micropsectra spp.	25	69	77	78	249	6%	62.3	25.2
Antocha sp.	11	2	12	5	30	1%	7.5	4.8
Hexatoma sp.	6	6	3	8	23	1%	5.8	2.1
Atherix pachypus	0	0	1	0	1	0%	0.3	0.5
Simulium spp.	4	8	88	34	134	3%	33.5	38.7
Chelifera sp.	1	0	4	0	5	0%	1.3	1.9
EPHEMEROPTERA						29%	282	
Ameletus sp.	0	1	0	0	1	0%	0.3	0.5
Baetis insignificans	12	9	7	6	34	1%	8.5	2.6
Baetis tricaudatus	124	211	313	227	875	22%	218.8	77.4
Attenella margarita	0	1	0	0	1	0%	0.3	0.5
Serratella tibialis	12	9	23	6	50	1%	12.5	7.4
Drunella doddsi	5	7	11	15	38	1%	9.5	4.4
Drunella grandis	1	1	0	0	2	0%	0.5	0.6
Epeorus sp.	0	3	5	4	12	0%	3.0	2.2
Rhithrogena sp.	11	32	36	31	110	3%	27.5	11.2
Paraleptophlebia sp.	0	0	0	1	1	0%	0.3	0.5
Tricorythodes minutus	1	3	0	0	4	0%	1.0	1.4
LEPIDOPTERA								
Petrophila sp.	4	8	6	3	21	1%	5.3	2.2

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Ninemile Prairie - STATION 12 - 8/11/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
PLECOPTERA						6%	58	
Calineuria californica	7	11	13	8	39	1%	9.8	2.8
Claassenia sabulosa	2	3	5	3	13	0%	3.3	1.3
Hesperoperla pacifica	0	1	3	1	5	0%	1.3	1.3
Perlodidae	6	0	3	0	9	0%	2.3	2.9
Pteronarcys californica	4	28	74	15	121	3%	30.3	30.8
Chloroperlinae	7	17	11	8	43	1%	10.8	4.5
TRICHOPTERA						37%	367	
Arctopsyche grandis	4	1	16	2	23	1%	5.8	6.9
Cheumatopsyche spp.	48	117	249	73	487	12%	121.8	89.5
Hydropsyche occidentalis	6	9	30	10	55	1%	13.8	11.0
Hydropsyche cockerelli	23	10	62	31	126	3%	31.5	22.1
H. (Ceratopsyche) spp.?	101	129	267	173	670	17%	167.5	72.7
Psychomyia flavida	9	13	16	4	42	1%	10.5	5.2
Brachycentrus occidentalis	2	3	24	1	30	1%	7.5	11.0
Rhyacophila sp.	0	3	2	3	8	0%	2.0	1.4
Culoptila sp	1	6	0	0	7	0%	1.8	2.9
ANNELIDA						0%	5	
Lumbriculidae	4	4	3	7	18	0%	4.5	1.7
OTHER								
Turbellaria	0	0	5	0	5	0%	1.3	2.5
TOTAL ORGANISMS	594	905	1507	922	3928		982	381
TAXA RICHNESS	40	44	39	39	52		41	2.4
SHAN. DIVERSITY	4.18	3.94	3.74	3.80	3.99		3.91	0.19
BIOTIC INDEX	4.47	4.35	4.29	4.54	4.39		4.41	0.11
EPT RICHNESS	20	24	20	20	26		21	2.0
EPT / CHIR.	2.95	4.42	10.83	3.91	5.20		5.5	3.6
% R.A. DOMINANT	21%	23%	21%	25%	22%		22%	1.9%
% R.A. FILTERERS	32%	31%	49%	35%	39%		37%	8.4%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Johnsrud Park - STATION 13 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						13%	163	
Optioservus spp.	44	39	43	58	184	4%	46.0	8.3
Zaitzevia sp.	109	106	137	117	469	9%	117.3	14.0
DIPTERA						21%	262	
nnassociated midge pupa	0	5	3	2	10	0%	2.5	2.1
Thienemannimyia gp.	8	4	6	3	21	0%	5.3	2.2
Pagastia sp	0	0	0	1	1	0%	0.3	0.5
Potthastia gaedii gp.	0	0	1	0	1	0%	0.3	0.5
Cardiocladius spp.	2	0	2	1	5	0%	1.3	1.0
Corynoneura sp	1	0	0	0	1	0%	0.3	0.5
Cricotopus spp.	16	2	1	12	31	1%	7.8	7.4
Eukiefferiella spp.	37	15	15	14	81	2%	20.3	11.2
Thienemanniella sp.	1	1	0	0	2	0%	0.5	0.6
Lopescladius sp.	2	0	0	0	2	0%	0.5	1.0
Nanocladius sp.	0	1	0	0	1	0%	0.3	0.5
Synorthocladius sp.	1	0	0	2	3	0%	0.8	1.0
Tvetenia sp.	5	3	4	3	15	0%	3.8	1.0
Polypedilum spp.	16	10	8	6	40	1%	10.0	4.3
Microtendipes sp	0	1	1	1	3	0%	0.8	0.5
Phaenopsectra sp	0	0	0	2	2	0%	0.5	1.0
Xenochironomus sp.	0	1	0	0	1	0%	0.3	0.5
Robackia sp.	1	0	0	0	1	0%	0.3	0.5
Rheotanytarsus sp.	0	1	0	3	4	0%	1.0	1.4
Micropsectra spp.	133	163	293	88	677	14%	169.3	88.1
Antocha sp.	5	2	4	6	17	0%	4.3	1.7
Hexatoma sp.	7	3	1	3	14	0%	3.5	2.5
Atherix pachypus	0	1	0	1	2	0%	0.5	0.6
Simulium sp.	49	10	31	19	109	2%	27.3	16.9
Chelifera sp.	0	1	0	2	3	0%	0.8	1.0
Protanyderus sp.	0	0	1	0	1	0%	0.3	0.5
EPHEMEROPTERA						24%	304	
Baetis insignificans	6	16	5	6	33	1%	8.3	5.2
Baetis tricaudatus	303	169	342	254	1068	21%	267.0	74.6
Serratella tibialis	0	1	2	1	4	0%	1.0	0.8
Ephemerella sp.	3	2	0	0	5	0%	1.3	1.5
Drunella doddsi	4	3	6	5	18	0%	4.5	1.3
Epeorus sp.	2	0	4	0	6	0%	1.5	1.9
Rhithrogena sp.	14	26	29	11	80	2%	20.0	8.8
LEPIDOPTERA								
Petrophila sp.	2	2	0	3	7	0%	1.8	1.3

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Johnsrud Park - STATION 13 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
PLECOPTERA						6%	73.	
Calineuria californica	11	6	27	9	53	1%	13.3	9.4
Claassenia sabulosa	1	3	1	3	8	0%	2.0	1.2
Hesperoperla pacifica	2	2	4	1	9	0%	2.3	1.3
Perlodidae	4	4	8	7	23	0%	5.8	2.1
Pteronarcys californica	19	17	43	66	145	3%	36.3	23.1
Chloroperlinea	17	20	7	8	52	1%	13.0	6.5
TRICHOPTERA						35%	437.	
Arctopsyche grandis	14	3	41	16	74	1%	18.5	16.1
Cheumatopsyche spp.	33	70	136	45	284	6%	71.0	46.0
Hydropsyche occidentalis	15	16	37	18	86	2%	21.5	10.4
Hydropsyche cockerelli	31	15	24	27	97	2%	24.3	6.8
H. (Ceratopsyche) spp.?	325	150	221	312	1008	20%	252.0	82.2
Leucotrichia pictipes	2	2	1	1	6	0%	1.5	0.6
Zumatrichia notosa	1	0	0	0	1	0%	0.3	0.5
Psychomyia flavida	41	18	8	25	92	2%	23.0	13.9
Brachycentrus occidentalis	4	2	24	15	45	1%	11.3	10.2
Rhyacophila angelita sp.	1	2	2	0	5	0%	1.3	1.0
Helicopsyche sp.	0	1	0	0	1	0%	0.3	0.5
Culoptila sp	7	11	5	0	23	0%	5.8	4.6
Glossosoma sp.	0	1	0	0	1	0%	0.3	0.5
ANNELIDA						0%	6	
Lumbricidae	0	9	0	8	17	0%	4.3	4.9
Lumbriculidae	3	2	1	0	6	0%	1.5	1.3
Tubificidae	0	0	0	1	1	0%	0.3	0.5
MOLLUSCA						0%	0	
Sphaeriidae	0	1	0	0	1	0%	0.3	0.5
OTHER								
Turbellaria	0	2	4	5	11	0%	2.8	2.2
TOTAL ORGANISMS	1302	945	1533	1191	4971		1243	244
TAXA RICHNESS	42	48	40	43	60		43	3.4
SHAN. DIVERSITY	3.62	3.85	3.59	3.64	3.76		3.68	0.12
BIOTIC INDEX	4.63	4.63	4.61	4.41	4.57		4.57	0.11
EPT RICHNESS	23	24	22	19	26		22	2.2
EPT / CHIR.	3.86	2.71	2.93	6.01	3.58		3.9	1.5
% R.A. DOMINANT	25%	18%	22%	26%	21%		23%	3.7%
% R.A. FILTERERS	36%	28%	34%	38%	34%		34%	4.3%

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Rainbow Bend - STATION 14 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
COLEOPTERA						11%	162	
Optioservus spp.	51	24	79	51	205	4%	51.3	22.5
Zaitzevia parvula	137	83	98	104	422	7%	105.5	22.8
Cleptelmis ornata	0	1	15	4	20	0%	5.0	6.9
Stenelmis sp.	1	0	1	0	2	0%	0.5	0.6
DIPTERA						41%	574	
unassociated midge pupa	27	6	7	4	44	1%	11.0	10.7
Thienemannimyia gp.	8	3	10	10	31	1%	7.8	3.3
Pagastia sp	1	0	0	0	1	0%	0.3	0.5
Potthastia longimanus gp.	1	0	0	1	2	0%	0.5	0.6
Cardiocladius spp.	29	14	25	18	86	2%	21.5	6.8
Corynoneura sp	1	0	0	1	2	0%	0.5	0.6
Cricotopus spp.	24	7	27	25	83	1%	20.8	9.3
Eukiefferiella spp.	210	62	20	7	299	5%	74.8	93.2
Orthocladius spp.	0	0	0	3	3	0%	0.8	1.5
Paraphaenocladius sp.	0	10	2	2	14	0%	3.5	4.4
Nanocladius sp.	1	1	3	1	6	0%	1.5	1.0
Synorthocladius sp.	1	0	2	1	4	0%	1.0	0.8
Tvetenia sp.	4	1	7	4	16	0%	4.0	2.4
Polypedilum spp.	39	15	17	5	76	1%	19.0	14.3
Microtendipes sp	0	2	3	2	7	0%	1.8	1.3
Phaenopsectra sp	0	0	1	0	1	0%	0.3	0.5
Cryptochironomus sp.	0	1	0	0	1	0%	0.3	0.5
Demicryptochironomus sp.	0	1	0	0	1	0%	0.3	0.5
Rheotanytarsus sp.	1	2	1	0	4	0%	1.0	0.8
Micropsectra spp.	123	73	275	99	570	10%	142.5	90.7
Antocha sp.	41	10	37	54	142	3%	35.5	18.5
Hexatoma sp.	2	0	0	0	2	0%	0.5	1.0
Atherix pachypus	3	1	2	1	7	0%	1.8	1.0
Simulium sp.	645	164	65	20	894	16%	223.5	287.4
EPHEMEROPTERA						18%	259	
Baetis insignificans	6	6	3	4	19	0%	4.8	1.5
Baetis tricaudatus	333	135	223	259	950	17%	237.5	82.3
Serratella tibialis	3	0	0	0	3	0%	0.8	1.5
Ephemerella sp.	2	1	0	0	3	0%	0.8	1.0
Drunella doddsi	4	1	3	2	10	0%	2.5	1.3
Drunella grandis	2	0	2	0	4	0%	1.0	1.2
Epeorus sp.	1	1	0	0	2	0%	0.5	0.6
Rhithrogena sp.	15	9	5	11	40	1%	10.0	4.2
Paraleptophlebia sp.	2	1	1	0	4	0%	1.0	0.8
LEPIDOPTERA								
Petrophila sp.	0	1	3	1	5	0%	1.3	1.3

MACROINVERTEBRATE DATA

BLACKFOOT RIVER at Rainbow Bend - STATION 14 - 8/10/88

Taxon	sample1	sample2	sample3	sample4	SUM	%RA	MEAN	S. D.
PLECOPTERA						4%	53	
Calineuria californica	29	16	17	13	75	1%	18.8	7.0
Claassenia sabulosa	4	0	4	1	9	0%	2.3	2.1
Hesperoperla pacifica	1	3	1	1	6	0%	1.5	1.0
Zapada cinctipes	1	0	0	1	2	0%	0.5	0.6
Skwala parallela	0	0	0	6	6	0%	1.5	3.0
Pteronarcys californica	6	6	29	27	68	1%	17.0	12.7
Chloroperlinae	23	10	8	5	46	1%	11.5	7.9
TRICHOPTERA						23%	326	
Arctopsyche grandis	11	4	14	9	38	1%	9.5	4.2
Cheumatopsyche spp.	30	41	105	108	284	5%	71.0	41.3
Hydropsyche occidentalis	1	71	20	25	117	2%	29.3	29.7
Hydropsyche cockerelli	13	7	27	21	68	1%	17.0	8.8
H. (Ceratopsyche) spp.?	247	45	153	204	649	11%	162.3	87.1
Limnephilidae	1	0	0	1	2	0%	0.5	0.6
Leucotrichia pictipes	1	1	1	3	6	0%	1.5	1.0
Hydroptila spp.	33	3	1	2	39	1%	9.8	15.5
Zumatrichia notosa	1	0	0	1	2	0%	0.5	0.6
Oecetis sp.	0	0	0	1	1	0%	0.3	0.5
Psychomyia flavida	7	2	1	53	63	1%	15.8	25.0
Brachycentrus occidentalis	0	0	0	1	1	0%	0.3	0.5
Rhyacophila angelita sp.	2	0	0	0	2	0%	0.5	1.0
Rhyacophila coloradensis	2	0	0	0	2	0%	0.5	1.0
Culoptila sp	1	1	1	0	3	0%	0.8	0.5
ANNELIDA						0%	7	
Lumbriculidae	3	4	5	13	25	0%	6.3	4.6
Tubificidae	0	0	2	0	2	0%	0.5	1.0
MOLLUSCA						0%	1	
Sphaeriidae	0	0	2	0	2	0%	0.5	1.0
OTHER								
Turbellaria	29	28	46	38	141	2%	35.3	8.5
TOTAL ORGANISMS	2164	878	1374	1228	5644		1411	543
TAXA RICHNESS	51	43	46	47	64		47	3.3
SHAN. DIVERSITY	3.55	3.98	3.97	3.95	4.06		3.87	0.21
BIOTIC INDEX	5.32	5.03	5.01	4.46	5.01		4.95	0.36
EPT RICHNESS	28	20	20	23	31		23	3.8
EPT / CHIR.	1.66	1.84	1.55	4.15	2.02		2.3	1.2
% R.A. DOMINANT	30%	19%	20%	21%	17%		22%	5.0%
% R.A. FILTERERS	44%	38%	28%	32%	36%		35%	7.0%

ID's by D. McGuire

Appendix C. Percentage Community Similarity coefficients (PCS X 100) for 14 Blackfoot River stations during August, 1988 (four square foot samples pooled at each station).

Station	1	2	3	4	5	6	7	8	9	10	11	12	13
1	-												
2	25	-											
3	10	35	-										
4	5	17	19	-									
5	9	21	22	**86**	-								
6	8	19	27	19	24	-							
7	6	20	21	26	28	20	-						
8	7	39	39	27	28	41	35	-					
9	8	39	34	57	56	38	35	**65**	-				
10	6	41	37	24	25	42	30	**81**	**65**	-			
11	7	36	36	42	41	31	47	**63**	**67**	**64**	-		
12	8	45	32	23	23	29	30	**69**	**55**	**67**	**70**	-	
13	7	43	34	21	21	35	29	**74**	**60**	**74**	**60**	**82**	-
14	7	38	35	35	34	31	42	**67**	**63**	**60**	**72**	**68**	**72**

PCS values >= 60 are **bold.**

Appendix D: STATISTICAL ANALYSES

Blackfoot River macroinvertebrate data

August, 1988

D.1 Total macroinvertebrate density

DataFile: UpperBFRdensities

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	63322540.2	6	10553756.7	3.3	0.020
Error	68147878.8	21	3245137.1		
Total	131470419.0	27			

Newman-Keuls test *.

station:	1	8	2	3	5	7	4
mean:	238	653	1869	2016	2087	3049	5154

DataFile: LowerBFRdensities

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	17538440.9	6	2923073.5	1.6	0.209
Error	39435813.5	21	1877895.9		
Total	56974254.4	27			

Newman-Keuls test *. **no significant differences.**

station:	12	13	14	11	8	10	9
mean:	982	1243	1411	1617	1823	2001	3585

* underscored values are not significantly different at P<= 0.05.

D.2 Taxa richness.

DataFile: Upper BFR taxa richness

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	1862.7	6	310.5	20.7	0.000
Error	315.0	21	15.0		
Total	2177.7	27			

Newman-Keuls test*.

station:	1	5	4	6	2	7	3
mean:	12	32	33	33	35	36	39

DataFile: Lower BFR taxa richness

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	561.7	6	93.6	7.9	0.000
Error	248.0	21	11.8		
Total	809.7	27			

Newman-Keuls test *.

station:	9	10	8	11	12	13	14
mean:	34	34	37	40	41	43	47

* underscored values are not significantly different at P<= 0.05.

D.3 Shannon diversity.

DataFile: UpperBFRShannondiversity

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	22.1	6	3.7	13.6	0.000
Error	5.7	21	0.3		
Total	27.8	27			

Newman-Keuls test *.

station:	1	4	5	6	7	3	2
mean:	1.3	1.7	2.0	3.1	3.2	3.5	3.7

DataFile: lowerBFRShannondiversity

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	2.0	6	0.3	3.5	0.015
Error	2.0	21	0.1		
Total	4.0	27			

Newman-Keuls test *. **No significant difference.**

station:	9	10	8	13	14	11	12
mean:	3.1	3.6	3.6	3.7	3.9	3.9	3.9

* underscored values are not significantly different at $P <= 0.05$.

D.4. Biotic index.

DataFile: upperBFRbiotic index

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	53.5	6	8.9	72.1	0.000
Error	2.6	21	0.1		
Total	56.1	27			

Newman-Keuls test *.

station:	1	8	2	3	5	7	4
mean:	1.5	2.4	4.0	4.6	4.9	5.0	5.5

DataFile: lowerBFRbiotic index

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	1.5	6	0.2	3.0	0.027
Error	1.7	21	0.1		
Total	3.2	27			

Newman-Keuls test *.

station:	12	11	13	8	10	14	9
mean:	4.4	4.5	4.6	4.8	4.9	5.0	5.1

* underscored values are not significantly different at P<= 0.05.

D.5 EPT richness

DataFile: upperBFREPTrichness

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	589.7	6	98.3	21.2	0.000
Error	97.3	21	4.6		
Total	687.0	27			

Newman-Keuls test *

station:	1	2	5	4	3	6	7
mean:	5	15	17	18	19	19	19

DataFile: lowerBFREPTrichness

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	106.0	6	17.7	3.1	0.026
Error	121.3	21	5.8		
Total	227.2	27			

Newman-Keuls test *.

station:	9	8	10	12	11	13	14
mean:	17	19	19	21	22	22	23

* underscored values are not significantly different at P<= 0.05.

D.6 Ephemeroptera, Plecoptera and Trichoptera to Chironomidae ratio.

DataFile: upper BFR EPT/C

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	518.8	6	86.5	3.6	0.013
Error	506.5	21	24.1		
Total	1025.3	27			

Newman-Keuls test *.

station:	3	2	4	6	7	1	5
mean:	1.2	1.4	2.2	5.9	6.2	9.3	13.8

DataFile: lower BFR EPT/C

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	38.6	6	6.4	1.8	0.152
Error	75.9	21	3.6		
Total	114.5	27			

Newman-Keuls test *. **No significant differences.**

station:	8	14	9	10	13	11	12
mean:	2.2	2.3	2.4	2.6	3.9	4.2	5.5

* underscored values are not significantly different at P<= 0.05.

D.7 Percent relative abundance of the numerically dominant taxon.

DataFile: %RA dominant taxon

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	10842.4	6	1807.1	10.9	0.000
Error	3475.8	21	165.5		
Total	14318.1	27			

Newman-Keuls test *.

station:	2	3	6	7	5	4	1
mean:	22	31	40	40	65	70	77

DataFile: lower BFR %RA dominant taxon

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	363.5	6	60.6	0.9	0.540
Error	1479.5	21	70.5		
Total	1843.0	27			

Newman-Keuls test *. **No significant differences.**

station:	8	13	14	12	10	9	11
mean:	29	34	35	37	41	43	47

* underscored values are not significantly different at P<= 0.05.

D.8 Percent relative abundance of filter-feeding macroinvertebrates.

DataFile: upper BFR %RA filterers

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between station	23438.7	6	3906.5	27.1	0.000
Error	3024.3	21	144.0		
Total	26463.0	27			

Newman-Keuls test *

station:	1	8	3	2	7	5	4
mean:	1	8	11	23	63	69	71

DataFile: lower BFR %RA filterers

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between stations	894.2	6	149.0	1.2	0.341
Error	2589.5	21	123.3		
Total	3483.7	27			

Newman-Keuls test *. **No significant differences.**

station:	8	13	14	12	10	9	11
mean:	29	34	35	37	41	43	47

* underscored values are not significantly different at $P <= 0.05$.

APPENDIX E

BLACKFOOT RIVER

PRIORITY POLLUTANT

ANALYSIS RESULTS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

Ref: 8ES-AS

OCT 6 1988

MEMORANDUM

TO: Del Nimmo, 8WM-SP

FROM: Marvin H. Frye, Chief
Special Environmental Analysis Section

SUBJECT: Blackfoot River Study - Final Analytical Results - Samples Collected August 2 and 3, 1988

Attached are final analytical results for the Blackfoot River Study. The samples were collected on August 2 and 3, 1988. The analytical data for the Volatiles, Semivolatiles and Metals analyses were forwarded to you on September 21, 1988.

Results included are:

Pesticides	4 Samples	Water

The original Chain of Custody forms (4) Nos. 8-09983, 8-09984, 8-09985 and 8-09986 were included with the previous transmittal.

Attachment

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH

CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37511
LOCATION : BLACKFOOT RIVER MT
ANALYST : WJM
SAMPLING STATION : 11

DATE-TIME SAMPLED : 08/03/88 14:55:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 10/06/88

REMARKS :

TEST	PARAMETER	RESULT
GC100	(GAS CHROMATOGRAPHY PEST'S & PCB'S AQUEOUS ug/l)	
	ALPHA-BHC	<.05
	BETA-BHC	<.05
	DELTA-BHC	<.05
	GAMMA-BHC	<.05
	HEPTACHLOR	<.05
	ALDRIN	<.05
	HEPTACHLOR EPOXIDE	<.05
	ENDOSULFAN I	<.05
	DIELDRIN	<.10
	4,4'-DDE	<.10
	ENDRIN	<.10
	ENDOSULFAN II	<.10
	4,4'-DDD	<.10
	ENDOSULFAN SULFATE	<.10
	4,4'-DDT	<.10
	METHOXYCHLOR	<.5
	ENDRIN KETONE	<.10
	GAMMA-CHLORDANE	<.5
	TOXAPHENE	<1.0
GC300	(G/C OF CHLORONATED HERBICIDES AQUEOUS ug/l)	
	2,4-D	<1
	2,4,5-T	<1
	2,4,5-TP	<1

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37503
LOCATION : BLACKFOOT RIVER MT
ANALYST : JWM
SAMPLING STATION : 06

DATE-TIME SAMPLED : 08/02/88 13:35:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 10/06/88

REMARKS :

TEST	PARAMETER	RESULT
GC100	(GAS CHROMATOGRAPHY PEST'S & PCB'S AQUEOUS ug/l)	
	AROCLOR 1016	
	AROCLOR 1248	
	AROCLOR 1254	
	AROCLOR 1260	
	ALPHA-BHC	<.05
	BETA-BHC	<.05
	DELTA-BHC	<.05
	GAMMA-BHC	<.05
	HEPTACHLOR	<.05
	ALDRIN	<.05
	HEPTACHLOR EPOXIDE	<.05
	ENDOSULFAN I	<.05
	DIELDRIN	<.10
	4,4'-DDE	<.10
	ENDRIN	<.10
	ENDOSULFAN II	<.10
	4,4'-DDD	<.10
	ENDOSULFAN SULFATE	<.10
	4,4'-DDT	<.10
	METHOXYCHLOR	<.5
	ENDRIN KETONE	<.10
	GAMMA-CHLORDANE	<.5
	TOXAPHENE	<1.0
GC300	(G/C OF CHLORONATED HERBICIDES AQUEOUS ug/l)	
	2,4-D	<1
	2,4,5-T	<1
	2,4,5-TP	<1

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37506
LOCATION : BLACKFOOT RIVER MT
ANALYST : WJM
SAMPLING STATION : 07

DATE-TIME SAMPLED : 08/01/88 13:05:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 10/06/88

REMARKS :

TEST	PARAMETER	RESULT
GC100	(GAS CHROMATOGRAPHY PEST'S & PCB'S AQUEOUS ug/l)	
	ALPHA-BHC	<.05
	BETA-BHC	<.05
	DELTA-BHC	<.05
	GAMMA-BHC	<.05
	HEPTACHLOR	<.05
	ALDRIN	<.05
	HEPTACHLOR EPOXIDE	<.05
	ENDOSULFAN I	<.05
	DIELDRIN	<.10
	4,4'-DDE	<.10
	ENDRIN	<.10
	ENDOSULFAN II	<.10
	4,4'-DDD	<.10
	ENDOSULFAN SULFATE	<.10
	4,4'-DDT	<.10
	METHOXYCHLOR	<.50
	ENDRIN KETONE	<.10
	GAMMA-CHLORDANE	<.50
	TOXAPHENE	<1.0
GC300	(G/C OF CHLORONATED HERBICIDES AQUEOUS ug/l)	
	2,4-D	<1
	2,4,5-T	<1
	2,4,5-TP	<1

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37515
LOCATION : BLACKFOOT RIVER MT
ANALYST : WJM
SAMPLING STATION : 14

DATE-TIME SAMPLED : 08/03/88 18:50:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 10/06/88

REMARKS :

TEST	PARAMETER	RESULT
GC100	(GAS CHROMATOGRAPHY PEST'S & PCB'S AQUEOUS ug/l)	
	AROCLOR 1248	
	ALPHA-BHC	<.05
	BETA-BHC	<.05
	DELTA-BHC	<.05
	GAMMA-BHC	<.05
	HEPTACHLOR	<.05
	ALDRIN	<.05
	HEPTACHLOR EPOXIDE	<.05
	ENDOSULFAN I	<.05
	DIELDRIN	<.10
	4,4'-DDE	<.10
	ENDRIN	<.10
	ENDOSULFAN II	<.10
	4,4'-DDD	<.10
	ENDOSULFAN SULFATE	<.10
	4,4'-DDT	<.10
	METHOXYCHLOR	<.5
	ENDRIN KETONE	<.10
	GAMMA-CHLORDANE	<.5
	TOXAPHENE	<1.0
GC300	(G/C OF CHLORONATED HERBICIDES AQUEOUS ug/l)	
	2,4-D	<1
	2,4,5-T	<1
	2,4,5-TP	<1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

Ref: 8ES-AS

SEP 21 1988

MEMORANDUM

TO: Del Nimmo, 8WM-SP

FROM: Marvin H. Frye, Chief
Special Environmental Analysis Section

SUBJECT: Blackfoot River Study - Analytical Results - Samples Collected August 2 & 3, 1988

Attached are analytical results for the Blackfoot River Study. The samples were collected on August 2 & 3, 1988.

Results included are:

Volatiles	4 Samples	Water
Semivolatiles	4 Samples	Water
Metals	4 Samples + 1 Field Blank	Water

Results not included are:

Pesticides	4 Samples	Water

Pesticide results will be transmitted when analyses are complete.

The original Chain of Custody forms (4) Nos. 8-09983, 8-09984, 8-09985 and 8-09986 are included herewith.

Attachment

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37519
LOCATION : BLACKFOOT RIVER MT
ANALYST : GRP
SAMPLING STATION : 06

DATE-TIME SAMPLED : 08/02/88 13:30:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 08/16/88

REMARKS : MAJORS ARE TOTAL METALS OTHERS ARE TR METALS

TEST	PARAMETER	RESULT
UV100	(ICP METALS AQUEOUS ug/l EXCEPT * mg/l)	
	CALCIUM*	42.4
	MAGNESIUM*	13.5
	SODIUM*	2.2
	ZINC	<10
AA100	(ATOMIC ABSORPTION AQUEOUS ug/l)	
	LEAD	<3.0
	COPPER	<1.0
	CADMIUM	1.0

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37505
LOCATION : BLACKFOOT RIVER MT
ANALYST : GRP
SAMPLING STATION : 07

DATE-TIME SAMPLED : 08/02/88 13:30:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 08/16/88

REMARKS : MAJORS ARE TOTAL METALS OTHERS ARE TR METALS

TEST	PARAMETER	RESULT
UV100	(ICP METALS AQUEOUS ug/l EXCEPT * mg/l)	
	CALCIUM*	34.6
	MAGNESIUM*	10.6
	SODIUM*	3.3
	ZINC	<10
AA100	(ATOMIC ABSORPTION AQUEOUS ug/l)	
	LEAD	<3.0
	COPPER	<1.0
	CADMIUM	0.7

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37509
LOCATION : BLACKFOOT RIVER MT
ANALYST : GRP
SAMPLING STATION : 11

DATE-TIME SAMPLED : 08/03/88 14:50:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 08/16/88

REMARKS : MAJORS ARE TOTAL METALS OTHERS ARE TR METALS

TEST	PARAMETER	RESULT
UV100	(ICP METALS AQUEOUS ug/l EXCEPT * mg/l)	
	CALCIUM*	29.0
	MAGNESIUM*	12.7
	SODIUM*	2.5
	ZINC	<10
AA100	(ATOMIC ABSORPTION AQUEOUS ug/l)	
	LEAD	<3.0
	COPPER	<1.0
	CADMIUM	0.9

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-37516
LOCATION : BLACKFOOT RIVER MT
ANALYST : GRP
SAMPLING STATION : 14

DATE-TIME SAMPLED : 08/03/88 18:45:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 08/16/88

REMARKS : MAJORS ARE TOTAL METALS OTHERS ARE TR METALS

TEST	PARAMETER	RESULT
UV100	(ICP METALS AQUEOUS ug/l EXCEPT * mg/l)	
	CALCIUM*	29.2
	MAGNESIUM*	12.9
	SODIUM*	3.0
	ZINC	<10
AA100	(ATOMIC ABSORPTION AQUEOUS ug/l)	
	LEAD	<3.0
	COPPER	<1.0
	CADMIUM	0.8

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : BFTRV\FB
LOCATION : BLACKFOOT RIVER MT
ANALYST : GRP
SAMPLING STATION : FIELD BLANK

DATE-TIME SAMPLED : 08/03/88 00:00:00
PROJECT CODE : CWA
DATE RECEIVED : 08/05/88
ANALYSIS COMPLETE DATE : 08/16/88

REMARKS : MAJORS ARE TOTAL METALS OTHERS ARE TR METALS

TEST	PARAMETER	RESULT
AA100	(ATOMIC ABSORPTION AQUEOUS ug/l)	
	LEAD	<3.0
	COPPER	<1.0
	CADMIUM	<0.5
UV100	(ICP METALS AQUEOUS ug/l EXCEPT * mg/l)	
	CALCIUM*	<0.2
	MAGNESIUM*	<0.2
	SODIUM*	<0.3
	ZINC	<10

SAMPLE NO. 8-37519 HARDNESS 161.4658

SAMPLE NO. 8-37505 HARDNESS 130.047

SAMPLE NO. 8-37516 HARDNESS 126.0346

SAMPLE NO. 8-37509 HARDNESS 124.7116

BLACKFOOT RIVER SURVEY

Samples Collected August 2 & 3, 1988

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: LAB BLANK 8-16-88
Tag Number: —
Sample Matrix: AQUEOUS

Case number: WATER QUALITY
Site: BLACKFOOT RIVER
Date Received: —
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 8-16-88
Date Analyzed: 8-16-88
Conc Factor: 1
Units: ug/l

MS File: BR1
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloromethane	<2	79-34-5	1,1,2,2-Tetrachloroethane	<2
74-83-9	Bromomethane		78-87-5	1,2-Dichloropropane	
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride		124-48-1	Dibromochloromethane	
67-64-1	Acetone	<10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	<2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloromethane		100-42-5	Styrene	
	2-Pentanone			Total Xylenes	

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 6
Tag Number: 8-37501
Sample Matrix: AQUEOUS

Case number: WATER QUALITY
Site: BLACKFOOT RIVER
Date Received: 8-2-88
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 8-16-88
Date Analyzed: 8-16-88
Conc Factor: 1
Units: ug/l

MS File: BR4
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloromethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane	↓	78-87-5	1,2-Dichloropropane	↓
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride		124-48-1	Dibromochloromethane	
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloromethane		100-42-5	Styrene	
	2-Pentanone	↓		Total Xylenes	↓

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 7
Tag Number: 8-37507
Sample Matrix: AQUEOUS

Case number: WATER QUALITY
Site: BLACKFOOT RIVER
Date Received: 8-2-88
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 8-16-88
Date Analyzed: 8-16-88
Conc Factor: 1
Units: ug/l

MS File: BR 5
Percent Moisture:
pH:
Dil Factor:

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloromethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane		78-87-5	1,2-Dichloropropane	
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride	↓	124-48-1	Dibromochloromethane	
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloromethane		100-42-5	Styrene	
	2-Pentanone	↓		Total Xylenes	↓

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 11
Tag Number: 8-37512
Sample Matrix: AQUEOUS

Case number: WATER QUALITY
Site: BLACKFOOT RIVER
Date Received: 8-3-88
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 8-16-88
Date Analyzed: 8-16-88
Conc Factor: 1
Units: ug/l

MS File: BR6
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloroethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromoethane	↓	78-87-5	1,2-Dichloropropane	↓
75-01-4	Vinyl Chloride	↓	10061-02-6	Trans-1,3-Dichloropropene	↓
75-00-3	Chloroethane	↓	79-01-6	Trichloroethene	↓
75-09-2	Methylene Chloride	↓	124-48-1	Dibromochloromethane	↓
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	↓
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	↓
75-35-4	1,1-Dichloroethene	↓	10061-01-5	Cis-1,3-Dichloropropene	↓
75-34-3	1,1-Dichloroethane	↓	110-75-8	2-Chloroethylvinylether	↓
156-60-5	Trans-1,2-Dichloroethene	↓	75-25-2	Bromoform	↓
67-66-3	Chloroform	↓	591-78-6	2-Hexanone	↓
107-06-2	1,2-Dichloroethane	↓	108-10-1	4-Methyl-2-Pentanone	↓
78-93-3	2-Butanone	↓	127-18-4	Tetrachloroethene	↓
71-55-6	1,1,1-Trichloroethane	↓	108-88-3	Toluene	↓
56-23-5	Carbon Tetrachloride	↓	108-90-7	Chlorobenzene	↓
108-05-4	Vinyl Acetate	↓	100-41-4	Ethylbenzene	↓
75-27-4	Bromodichloromethane	↓	100-42-5	Styrene	↓
	2-Pentanone	↓		Total Xylenes	↓

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 14
Tag Number: 8-37517
Sample Matrix: AQUEOUS

Case number: WATER QUALITY
Site: BLACKFOOT RIVER
Date Received: 8-3-88
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 8-16-88
Date Analyzed: 8-16-88
Conc Factor: 1
Units: ug/l

MS File: BR7
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloromethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane	↓	78-87-5	1,2-Dichloropropane	↓
75-01-4	Vinyl Chloride	↓	10061-02-6	Trans-1,3-Dichloropropene	↓
75-00-3	Chloroethane	↓	79-01-6	Trichloroethene	↓
75-09-2	Methylene Chloride	↓	124-48-1	Dibromochloromethane	↓
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	↓
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	↓
75-35-4	1,1-Dichloroethene	↓	10061-01-5	Cis-1,3-Dichloropropene	↓
75-34-3	1,1-Dichloroethane	↓	110-75-8	2-Chloroethylvinylether	↓
156-60-5	Trans-1,2-Dichloroethene	↓	75-25-2	Bromoform	↓
67-66-3	Chloroform	↓	591-78-6	2-Hexanone	↓
107-06-2	1,2-Dichloroethane	↓	108-10-1	4-Methyl-2-Pentanone	↓
78-93-3	2-Butanone	↓	127-18-4	Tetrachloroethene	↓
71-55-6	1,1,1-Trichloroethane	↓	108-88-3	Toluene	↓
56-23-5	Carbon Tetrachloride	↓	108-90-7	Chlorobenzene	↓
108-05-4	Vinyl Acetate	↓	100-41-4	Ethylbenzene	↓
75-27-4	Bromodichloromethane	↓	100-42-5	Styrene	↓
	2-Pentanone	↓		Total Xylenes	↓

PROJECT : BLACKFOOT RIVER

DATE : 8-16-88

SUBSTRATE : AQUEOUS

SPIKE LEVEL : 40 ug/l

VOLATILES

GC/MS FILE	SAMPLE	TAG #	% RECOVERY 1,2-DICHLORO-ETHANE-D4	D8-TOLUENE	COMMENTS
BR1	BLANK 8-16-88	—	93.6	98.5	
BR4	STATION 6	8-37501	108	95.1	
BR5	STATION 7	8-37507	105	94.0	
BR6	STATION 11	8-37512	104	96.3	
BR7	STATION 14	8-37517	108	96.8	
	CUSUM	$\bar{P}$	101	100	
	DATA	S.D.	11.1	10.6	
	BASE	$\bar{P} \pm 2SD$	79.0-123	78.7-121	
		# OF DATA Points	533	520	
	ALL RECOVERIES	ARE WITHIN	THE 95%	CONFIDENCE	LIMITS

ORGANIC LAB RESULTS

USEPA REGION 8

Date: AUG. 24, 1988

Case #:

Date Sampled: 8/2 & 3

Sample Matrix: Water

Sample ID: 8-33500 8-37504, 8-37510, 8-37514

Analyst: MS OPERATOR JOAN W. BRAHURST

Location: BLACK FOOT RIVER SM

Date Analyzed: 8/10 - 8/11, 1988

Parameters: SEMIVOLATILES

Sample Size: 1 liter

Final Volume: 1ml

Extraction Method: LAN - Method 625

Instrument: PARCOS 50

Column: SPB-5

Flows: ~ 3-4 ml/min

Detector: MS

Temperature: programmed

Injection Size: ~ 2 ul

Comments:

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: NEVADA OGDEN

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-33500

FRN 70056

Sample wt/vol: 1 Liter (g/mL) ____ Lab File ID: 8-33500

Level: (low/med) _____ Date Received: 8-5-88

% Moisture: not dec. ✓ dec. _____ Date Extracted: 8-8-88

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: 1 Liter → 1 ml

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
108-95-2	Phenol	56	
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene	✓	

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-33500

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
99-09-2	3-Nitroaniline	5U	
83-32-9	Acenaphthene	5U	
51-28-5	2,4-Dinitrophenol	10U	
100-02-7	4-Nitrophenol	10U	
132-64-9	Dibenzofuran	5U	
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate	1.3 J	
117-84-0	Di-n-octylphthalate	5U	
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BLACK FOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-33500

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-83

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

Number TICs found: _____ CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
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1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

HELMVILLE 2/2

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-37504

FRN 70053

Sample wt/vol: 1liter (g/mL) ____ Lab File ID: 8-37504

Level: (low/med) _____ Date Received: 8-5-88

% Moisture: not dec. ✓ dec. _____ Date Extracted: 8-8-88

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ____ pH: ____ Dilution Factor: 1liter ⇒ 1ml

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND	CONCENTRATION	Q
108-95-2	Phenol	54	
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-3	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene	V	

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA - REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: B-37504

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
99-09-2	3-Nitroaniline	5U	
83-32-9	Acenaphthene	5U	
51-28-5	2,4-Dinitrophenol	10U	
100-02-7	4-Nitrophenol	10U	
132-64-9	Dibenzofuran	5U	
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene	U	
218-01-9	Chrysene	U	
117-81-7	bis(2-Ethylhexyl)phthalate	1.4J	
117-84-0	Di-n-octylphthalate	5U	
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene	U	

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-37504

Sample wt/vol: _____ (g/mL) _____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ___ Dilution Factor: _____

Number TICs found: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		None			
2.					
3.					
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

ROUND 2 BAT 32.

BLACK FOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

FRN 70053

Matrix: (soil/water) _____ Lab Sample ID: 8-37510

Sample wt/vol: liter (g/mL) ____ Lab File ID: 8-37510

Level: (low/med) _____ Date Received: 8-5-88

% Moisture: not dec. ✓ dec. _____ Date Extracted: 8-8-88

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: liter → 1 ml

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND	(ug/L or ug/Kg)	Q
108-95-2	Phenol	54	
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene		

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-37510

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
99-09-2	3-Nitroaniline	5U	
83-32-9	Acenaphthene	5U	
51-28-5	2,4-Dinitrophenol	10U	
100-02-7	4-Nitrophenol	10U	
132-64-9	Dibenzofuran	5U	
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate		
117-84-0	Di-n-octylphthalate		
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene	V	

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: R-37510

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: _____

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

Number TICs found: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	NONE			
2.				
3.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

USGS SF-NT201

BLACKFOOT RIVER SKAVEN

Lab Name: EPA REGION VIII Contract:

Lab Code: Case No.: SAS No.: SDG No.:

Matrix: (soil/water) water Lab Sample ID: 8-37514 FAN 70054

Sample wt/vol: liter (g/mL) Lab File ID: 8-37514

Level: (low/med) Date Received: 8-5-88

% Moisture: not dec. ✓ dec. Date Extracted: 8-3-88

Extraction: (SepF/Cont/Sonc) Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) N pH: Dilution Factor: liter → 1 mL

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	Q
108-95-2	Phenol	54	
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene	U	
606-20-2	2,6-Dinitrotoluene	U	

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-3754

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	Q
99-09-2	3-Nitroaniline	5U	
83-32-9	Acenaphthene	5U	
51-28-5	2,4-Dinitrophenol	10U	
100-02-7	4-Nitrophenol	10U	
132-64-9	Dibenzofuran	5U	
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate	1.4J	
117-84-0	Di-n-octylphthalate	5U	
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BLACK FOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-37514

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-11-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

Number TICs found: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
2.				
3.				
4.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: Blank

Sample wt/vol: 1 liter (g/mL) ____ Lab File ID: Blank

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: 8-8-88

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-10-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: 1 liter → 1 ml

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
108-95-2	Phenol	5U	
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-3	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene		

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: Blank

Sample wt/vol: 1 liter (g/mL) _____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. ✓ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-10-88

GPC Cleanup: (Y/N) ___ pH: ___ Dilution Factor: _____

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
99-09-2	3-Nitroaniline	5U	
83-32-9	Acenaphthene	5U	
51-28-5	2,4-Dinitrophenol	10U	
100-02-7	4-Nitrophenol	10U	
132-64-9	Dibenzofuran	5U	
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate	2.5J	
117-84-0	Di-n-octylphthalate		
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene	✓	

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BUCKHEADS RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: Blank

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-10-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

Number TICs found: _____ CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
2.				
3.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLANK V-001
RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: FAN 70050 8-33500 Method Blank

Sample wt/vol: 1 Liter (g/mL) ____ Lab File ID: 8-33500 MS

Level: (low/med) _____ Date Received: 8-5-88

% Moisture: not dec. ✓ dec. _____ Date Extracted: 8-8-88

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-10-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: Water → 1:1 mL

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	Q
108-95-2	Phenol MS	57.9	
111-44-4	bis(2-Chloroethyl)ether	54	
95-57-8	2-Chlorophenol MS	80.2	
541-73-1	1,3-Dichlorobenzene	54	
106-46-7	1,4-Dichlorobenzene MS	34.5	
100-51-6	Benzyl alcohol	54	
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine MS	43.3	
67-72-1	Hexachloroethane	54	
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene MS	40.2	
91-20-3	Naphthalene	54	
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol MS	127.9	
91-57-6	2-Methylnaphthalene	54	
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene		

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: MS 8-33520

Sample wt/vol: _____ (g/mL) _____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 8-10-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		CONCENTRATION (ug/L or ug/Kg)	Q
99-09-2	3-Nitroaniline		54	
83-32-9	Acenaphthene	MS	42.9	
51-28-5	2,4-Dinitrophenol		104	
100-02-7	4-Nitrophenol		104	
132-64-9	Dibenzofuran		54	
121-14-2	2,4-Dinitrotoluene	MS	53.9	
84-66-2	Diethylphthalate		54	
7005-72-3	4-Chlorophenyl-phenylether			
86-73-7	Fluorene			
100-01-6	4-Nitroaniline			
534-52-1	4,6-Dinitro-2-methylphenol			
86-30-6	N-Nitrosodiphenylamine (1)			
101-55-3	4-Bromophenyl-phenylether			
118-74-1	Hexachlorobenzene			
87-86-5	Pentachlorophenol	MS	120.3	
85-01-8	Phenanthrene		54	
120-12-7	Anthracene			
84-74-2	Di-n-butylphthalate			
206-44-0	Fluoranthene			
129-00-0	Pyrene	MS	65.2	
85-68-7	Butylbenzylphthalate		54	
91-94-1	3,3'-Dichlorobenzidine			
56-55-3	Benzo(a)anthracene			
218-01-9	Chrysene			
117-81-7	bis(2-Ethylhexyl)phthalate		4.4 J	
117-84-0	Di-n-octylphthalate			
205-99-2	Benzo(b)fluoranthene			
207-08-9	Benzo(k)fluoranthene			
50-32-8	Benzo(a)pyrene			
193-39-5	Indeno(1,2,3-cd)pyrene			
53-70-3	Dibenz(a,h)anthracene			
191-24-2	Benzo(g,h,i)perylene			

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

BLACKFOOT RIVER SURVEY

Lab Name: EPA REGION VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: MB 8-33500

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 3-10-88

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

Number TICs found: _____ CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	NONE			
2.				
3.				
4.				
5.				
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WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Aug. 1988

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____

BLACKFOOT RIVER SURVE

COMPOUND	AMOUNT ADDED (ng)	SAMPLE CONC. IN EXTRACT (ug/L)	MS CONC. IN EXTRACT (ug/L)	MS% REC #	QC LIMITS REC.
Phenol	100		57.9	57.9	12-89
2-Chlorophenol	100		80.2	80.2	27-123
1,4-Dichloro-benzene	50		34.5	69.0	36-97
N-Nitroso-di-n-Propylamine	50		43.8	87.6	41-116
1,2,4-Trichloro-benzene	50		40.2	80.4	39-98
4-Chloro-3-Methyl-phenol	100		127.9	127.9	23-97
Acenaphthene	50		42.9	85.8	46-118
4-Nitrophenol	100		53.5	53.5	10-80
2,4-Dinitrotoluene	50		53.9	53.9	24-96
Pentachlorophenol	100		120.3	120.3	9-103
Pyrene	50		65.2	130.0	26-127

COMPOUND	MSD CONC. IN EXTRACT(ug/L)	MSD% REC #	MS% REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol					42	12-89
2-Chlorophenol					40	27-123
1,4-Dichloro-benzene					28	36-97
N-Nitroso-di-n-Propylamine					38	41-116
1,2,4-Trichloro-benzene					28	39-98
4-Chloro-3-Methyl-phenol					42	23-97
Acenaphthene					31	46-118
4-Nitrophenol					50	10-80
2,4-Dinitrotoluene					38	24-96
Pentachlorophenol					50	9-103
Pyrene					31	26-127

Column to be used to flag recovery and RPD values with an asterisk
Values outside of QC limits

RPD: _____ out of _____ outside limits
Spike Recovery: _____ out of _____ outside limits

COMMENTS: _____

SAMPLE NAME: 8-37510	SAMPLE VALUE: 57.5
SAMPLE NAME: 8-37514	SAMPLE VALUE: 70.3
SAMPLE NAME: 8-37504	SAMPLE VALUE: 65.5
SAMPLE NAME: 8-33500	SAMPLE VALUE: 68.1
SAMPLE NAME: BLANK	SAMPLE VALUE: 71.8
SAMPLE NAME: MS8-33500	SAMPLE VALUE: 66.1

NEW DATA SET

USER: JOAN MANHART DATE: 8-24-88

PROJECT: BLACKFOOT RIVER SAMPLE MATRIX: WATER

CHEMICAL COMPOUND: 2-FLUOROPHENOL

NEW DATA SET PARAMETERS

MEAN: 66.55 %

STANDARD DEVIATION: 5.044502 %

RSD: 7.580018 %

THE 95% CONF. LIMITS(2SD) ARE 56.460996 TO 76.639004 %

UPDATED DATA BASE PARAMETERS

SAMPLE MATRIX: WATER CHEMICAL COMPOUND: 2-FLUOROPHENOL

DATE: 8-24-88

MEAN: 66.55 %

STANDARD DEVIATION: 5.044502 %

RSD: 7.580018 %

THE 95% CONF. LIMITS(2SD) ARE 56.460996 TO 76.639004 %

THE 99% CONF. LIMITS (3SD) ARE 51.416494 TO 81.683506 %

SAVE THESE VALUES FOR FUTURE USE

S1= 3.993 S2= 2.670065 N= 6

SAMPLE NAME: 8-37510	SAMPLE VALUE: 46.9
SAMPLE NAME: 8-37514	SAMPLE VALUE: 53.2
SAMPLE NAME: 8-37504	SAMPLE VALUE: 50.1
SAMPLE NAME: 8-33500	SAMPLE VALUE: 49
SAMPLE NAME: BLANK	SAMPLE VALUE: 57.4
SAMPLE NAME: MS8-33500	SAMPLE VALUE: 62.9

NEW DATA SET

USER: JOAN MANHART DATE: 8-24-88

PROJECT: BLACKFOOT RIVER SAMPLE MATRIX: WATER

CHEMICAL COMPOUND: D5-PHENOL

NEW DATA SET PARAMETERS

MEAN: 53.25 %

STANDARD DEVIATION: 5.9775413 %

RSD: 11.22543 %

THE 95% CONF. LIMITS(2SD) ARE 41.294917 TO 65.205083 %

UPDATED DATA BASE PARAMETERS

SAMPLE MATRIX: WATER CHEMICAL COMPOUND: D5-PHENOL

DATE: 8-24-88

MEAN: 59.9 %

STANDARD DEVIATION: 8.7207172 %

RSD: 14.558793 %

THE 95% CONF. LIMITS(2SD) ARE 42.458566 TO 77.341434 %

THE 99% CONF. LIMITS (3SD) ARE 33.737848 TO 86.062152 %

SAVE THESE VALUES FOR FUTURE USE

S1= 7.188 S2= 4.389268 N= 12

SAMPLE NAME: 8-37510	SAMPLE VALUE: 65.8
SAMPLE NAME: 8-37514	SAMPLE VALUE: 76.8
SAMPLE NAME: 8-37504	SAMPLE VALUE: 78.6
SAMPLE NAME: 8-33500	SAMPLE VALUE: 75.2
SAMPLE NAME: BLANK	SAMPLE VALUE: 87.6
SAMPLE NAME: MS8-33500	SAMPLE VALUE: 95.6

NEW DATA SET

USER: JOAN MANHART DATE: 8-24-88

PROJECT: BLACKFOOT RIVER SAMPLE MATRIX: WATER

CHEMICAL COMPOUND: D5-NITROBENZENE

NEW DATA SET PARAMETERS

MEAN: 79.933333 %

STANDARD DEVIATION: 10.372785 %

RSD: 12.976795 %

THE 95% CONF. LIMITS(2SD) ARE 59.187764 TO 100.6789 %

UPDATED DATA BASE PARAMETERS

SAMPLE MATRIX: WATER CHEMICAL COMPOUND: D5-NITROBENZENE

DATE: 8-24-88

MEAN: 66.577778 %

STANDARD DEVIATION: 13.239582 %

RSD: 19.885888 %

THE 95% CONF. LIMITS(2SD) ARE 40.098613 TO 93.056942 %

THE 99% CONF. LIMITS (3SD) ARE 26.859031 TO 106.29652 %

SAVE THESE VALUES FOR FUTURE USE

S1= 11.984 S2= 8.276668 N= 18

SAMPLE NAME: 8-37510	SAMPLE VALUE: 70.6
SAMPLE NAME: 8-37514	SAMPLE VALUE: 80
SAMPLE NAME: 8-37504	SAMPLE VALUE: 78.2
SAMPLE NAME: 8-33500	SAMPLE VALUE: 76.4
SAMPLE NAME: BLANK	SAMPLE VALUE: 68.8
SAMPLE NAME: MS8-33500	SAMPLE VALUE: 74.6

NEW DATA SET

USER: JOAN MANHART DATE: 8-24-88

PROJECT: BLACKFOOT RIVER SAMPLE MATRIX: WATER

CHEMICAL COMPOUND: 2-FLUOROBIPHENYL

NEW DATA SET PARAMETERS

MEAN: 74.766667 %

STANDARD DEVIATION: 4.3550737 %

RSD: 5.8248868 %

THE 95% CONF. LIMITS(2SD) ARE 66.056519 TO 83.476814 %

UPDATED DATA BASE PARAMETERS

SAMPLE MATRIX: WATER CHEMICAL COMPOUND: 2-FLUOROBIPHENYL

DATE: 8-24-88

MEAN: 68.625 %

STANDARD DEVIATION: 12.116222 %

RSD: 17.655696 %

THE 95% CONF. LIMITS(2SD) ARE 44.392557 TO 92.857443 %

THE 99% CONF. LIMITS (3SD) ARE 32.276335 TO 104.97366 %

SAVE THESE VALUES FOR FUTURE USE

S1= 16.47 S2= 11.640184 N= 24

SAMPLE NAME: 8-37510	SAMPLE VALUE: 84.4
SAMPLE NAME: 8-37514	SAMPLE VALUE: 94.2
SAMPLE NAME: 8-37504	SAMPLE VALUE: 92.5
SAMPLE NAME: 8-33500	SAMPLE VALUE: 99.1
SAMPLE NAME: BLANK	SAMPLE VALUE: 110.9
SAMPLE NAME: MS8-33500	SAMPLE VALUE: 119.8

NEW DATA SET

USER: JOAN MANHART DATE: 8-24-88

PROJECT: BLACKFOOT RIVER SAMPLE MATRIX: WATER

CHEMICAL COMPOUND: 2, 4,6-TRIBROMOPHENOL

NEW DATA SET PARAMETERS

MEAN: 100.15 %

STANDARD DEVIATION: 12.998269 %

RSD: 12.978801 %

THE 95% CONF. LIMITS(2SD) ARE 74.153462 TO 126.14654 %

UPDATED DATA BASE PARAMETERS

SAMPLE MATRIX: WATER CHEMICAL COMPOUND: 2

DATE: 8-24-88

MEAN: 74.93 %

STANDARD DEVIATION: 17.608387 %

RSD: 23.499782 %

THE 95% CONF. LIMITS(2SD) ARE 39.713227 TO 110.14677 %

THE 99% CONF. LIMITS (3SD) ARE 22.10484 TO 127.75516 %

SAVE THESE VALUES FOR FUTURE USE

S1= 22.479 S2= 17.742675 N= 30

SAMPLE NAME: 8-37510	SAMPLE VALUE: 92.9
SAMPLE NAME: 8-37514	SAMPLE VALUE: 91.4
SAMPLE NAME: 8-37504	SAMPLE VALUE: 80.6
SAMPLE NAME: 8-33500	SAMPLE VALUE: 78.6
SAMPLE NAME: BLANK	SAMPLE VALUE: 107.6
SAMPLE NAME: MS8-33500	SAMPLE VALUE: 71.1

NEW DATA SET

USER: JOAN MANHART DATE: 8-24-88

PROJECT: BLACKFOOT RIVER SAMPLE MATRIX: WATER

CHEMICAL COMPOUND: D14-TERPHENYL

NEW DATA SET PARAMETERS

MEAN: 87.033333 %

STANDARD DEVIATION: 12.983477 %

RSD: 14.917821 %

THE 95% CONF. LIMITS(2SD) ARE 61.06638 TO 113.00029 %

UPDATED DATA BASE PARAMETERS

SAMPLE MATRIX: WATER CHEMICAL COMPOUND: D14-TERPHENYL

DATE: 8-24-88

MEAN: 76.947222 %

STANDARD DEVIATION: 17.375607 %

RSD: 22.581201 %

THE 95% CONF. LIMITS(2SD) ARE 42.196009 TO 111.69844 %

THE 99% CONF. LIMITS (3SD) ARE 24.820402 TO 129.07404 %

SAVE THESE VALUES FOR FUTURE USE

S1= 27.701 S2= 22.371841 N= 36

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

MAY 1989 RECEIVED

Ref: 8ES-AS

MAY 24 1989

MEMORANDUM

TO: ~~David Buiter, 8WM-SP~~ Mark Kerr
~~Physical Scientist~~ MT WQB

FROM: Marvin H. Frye, Chief
Special Environmental Analysis Section

936-5073

SUBJECT: Blackfoot River Bioassay, MT - Analytical Results - Samples Collected April 24, 1989

Attached are final analytical results for the Blackfoot River Bioassay Project. The samples were collected on April 24, 1989.

Results included are:

Volatiles	4 Samples	Water
Semivolatiles	4 Samples	Water
Metals - ICP	5 Samples	Water
Metals - AA	5 Samples	Water
Pesticides	4 Samples	Water

The original Chain of Custody forms (5) Nos. 8-10686, 8-10687, 8-10688, 8-10689, and 8-10690 are included herewith.

Attachment

Mark- I believe these results are yours.

Dave

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15667
LOCATION : BLACKFOOT RVR BIO
ANALYST : GRP
SAMPLING STATION : 03 HOLDUM BRIDGE

DATE-TIME SAMPLED : 04/24/89 09:30:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 05/05/89

REMARKS : SEE BELOW

TEST	PARAMETER		RESULT (ug/l)
UV200	(ICP METALS)		
	CALCIUM*		14.6
	MAGNESIUM*		6.8
	SODIUM*		1.6
	ZINC	TR	53
AA213	(AAGF CADMIUM)		
	CADMIUM		<0.5
AA220	(AAGF COPPER)		
	COPPER	TR	1.5
AA239	(AAGF LEAD)		
	LEAD		<3.0

REMARKS:

+ MAJOR METALS, CADMIUM & LEAD - "TOTAL"
+ ZINC & COPPER - "TOTAL EXTRACTABLE"
+ ZINC- TOTAL = 51 ug/L
+ COPPER - TOTAL = 3.9 ug/L
+ "TOTAL EXTRACTABLE" = NO DIGESTION; ANALYZED SUPERNATANT OF FIELD ACIDIFIED SAMPLE

* mg/L

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ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15609
LOCATION : BLACKFOOT RVR BIO
ANALYST : GRP
SAMPLING STATION : 07 HELMVILLE BR

DATE-TIME SAMPLED : 04/24/89 11:15:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 05/05/89

REMARKS : SEE BELOW

TEST	PARAMETER		RESULT (ug/l)
UV200	(ICP METALS)		
	CALCIUM*		30.3
	MAGNESIUM*		10.4
	SODIUM*		3.0
	ZINC	TR	<10
AA213	(AAGF CADMIUM)		
	CADMIUM		<0.5
AA220	(AAGF COPPER)		
	COPPER	TR	5.1
AA239	(AAGF LEAD)		
	LEAD		3.9

REMARKS:

+ MAJOR METALS, CADMIUM & LEAD - TOTAL
+ ZINC & COPPER - "TOTAL EXTRACTABLE"
+ ZINC - TOTAL = 17 ug/L
+ COPPER - TOTAL = 10.2 ug/L
+ "TOTAL EXTRACTABLE" = NO DIGESTION; ANALYZED SUPERNATANT OF FIELD ACIDIFIED SAMPLE

* mg/L

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ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15605
LOCATION : BLACKFOOT RVR BIO
ANALYST : GRP
SAMPLING STATION : 11 ROUNDUP BAR 32

DATE-TIME SAMPLED : 04/24/89 13:00:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 05/05/89

REMARKS : TOTAL METALS; * mg/L

TEST	PARAMETER	RESULT (ug/l)
UV200	(ICP METALS)	
	CALCIUM*	19.2
	MAGNESIUM*	6.8
	SODIUM*	1.6
	ZINC	<10
AA213	(AAGF CADMIUM)	
	CADMIUM	<0.5
AA220	(AAGF COPPER)	
	COPPER	1.5
AA239	(AAGF LEAD)	
	LEAD	<3.0

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ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15968
LOCATION : BLACKFOOT RVR BIO
ANALYST : GRP
SAMPLING STATION : 14 AT USGS STATION

DATE-TIME SAMPLED : 04/24/89 14:00:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 05/05/89

REMARKS : SEE BELOW

TEST	PARAMETER	RESULT (ug/l)
UV200	(ICP METALS)	
	CALCIUM*	19.2
	MAGNESIUM*	6.5
	SODIUM*	1.7
	ZINC	TR <10
AA213	(AAGF CADMIUM)	
	CADMIUM	<0.5
AA220	(AAGF COPPER)	
	COPPER	TR <1.0
AA239	(AAGF LEAD)	
	LEAD	<3.0

REMARKS:

+ MAJOR METALS, CADMIUM & LEAD - TOTAL
+ ZINC & COPPER - "TOTAL EXTRACTABLE"
+ ZINC - TOTAL = 13 ug/L
+ COPPER - TOTAL = 2.8 ug/L
+ "TOTAL EXTRACTABLE" = NO DIGESTION; ANALYZED SUPERNATANT OF FIELD ACIDIFIED SAMPLE

* mg/L

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REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15971
LOCATION : BLACKFOOT RVR BIO
ANALYST : GRP
SAMPLING STATION : FIELD BLANK

DATE-TIME SAMPLED : 04/24/89 11:15:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 05/05/89

REMARKS : TOTAL METALS; * mg/L

TEST	PARAMETER	RESULT (ug/l)
UV200	(ICP METALS)	
	CALCIUM*	<0.2
	MAGNESIUM*	<0.2
	SODIUM*	<0.3
	ZINC	<10
AA213	(AAGF CADMIUM)	
	CADMIUM	<0.5
AA220	(AAGF COPPER)	
	COPPER	<1.0
AA239	(AAGF LEAD)	
	LEAD	<3.0

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ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15611
LOCATION : BLACKFOOT RVR BIO
ANALYST : WJM
SAMPLING STATION : 03 HGWM CR 32100E

DATE-TIME SAMPLED : 04/24/89 09:30:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 5/24/89

REMARKS :

TEST	PARAMETER	RESULT (ug/l)
GC608	(G/C PESTICIDES & PCB'S)	
	HEPTACHLOR	<.02 u
	ALDRIN	<.04 u
	HEPTACHLOR EPOXIDE	<.06 u
	DIELDRIN	<.08 u
	4,4'-DDE	<.08 u
	4,4'-DDD	<.16 u
	4,4'-DDT	<.20 u
	ALPHA-CHLORDANE	<.50 u

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ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15607
LOCATION : BLACKFOOT RVR BIO
ANALYST : WJM
SAMPLING STATION : 07 HELMVILLE BR.

DATE-TIME SAMPLED : 04/24/89 11:15:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 5/24/89

REMARKS :

TEST	PARAMETER	RESULT (ug/l)
GC608	(G/C PESTICIDES & PCB'S)	
	HEPTACHLOR	<.02 u
	ALDRIN	<.04 u
	HEPTACHLOR EPOXIDE	<.06 u
	DIELDRIN	<.08 u
	4,4'-DDE	<.08 u
	4,4'-DDD	<.16 u
	4,4'-DDT	<.20 u
	ALPHA-CHLORDANE	<.50 u

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ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15602
LOCATION : BLACKFOOT RVR BIO
ANALYST : WJM
SAMPLING STATION : 11 ROUNDUP BRE BR

DATE-TIME SAMPLED : [illegible] :00:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 5/24/89

REMARKS :

TEST	PARAMETER	RESULT (ug/l)
GC608	(G/C PESTICIDES & PCB'S)	
	HEPTACHLOR	<.02 u
	ALDRIN	<.04 u
	HEPTACHLOR EPOXIDE	<.06 u
	DIELDRIN	<.08 u
	4,4'-DDE	<.08 u
	4,4'-DDD	<.16 u
	4,4'-DDT	<.20 u
	ALPHA-CHLORDANE	<.50 u

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REGION VIII
ENVIRONMENTAL SERVICES DIVISION

ANALYTICAL SUPPORT BRANCH — CERTIFICATE OF ANALYSIS

SAMPLE NUMBER : 8-15970
LOCATION : BLACKFOOT RVR BIO
ANALYST : WJM
SAMPLING STATION : 14 USGS STATION

DATE-TIME SAMPLED : 04/24/89 14:00:00
PROJECT CODE : CWA
DATE RECEIVED : 04/26/89
ANALYSIS COMPLETE DATE : 5/24/89

REMARKS :

TEST	PARAMETER	RESULT (ug/l)
GC608	(G/C PESTICIDES & PCB'S)	
	HEPTACHLOR	<.02 u
	ALDRIN	<.04 u
	HEPTACHLOR EPOXIDE	<.06 u
	DIELDRIN	<.08 u
	4,4'-DDE	<.08 u
	4,4'-DDD	<.16 u
	4,4'-DDT	<.20 u
	ALPHA-CHLORDANE	<.50 u

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: LAB BLANK 4-27-89
Tag Number: —
Sample Matrix: AQUEOUS

Case number: AMBIENT / EFFLUENT
Site: BLACKFOOT RIVER
Date Received: —
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 4-27-89
Date Analyzed: 4-27-89
Conc Factor: 1
Units: ug/l

MS File: BF4
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloromethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane		78-87-5	1,2-Dichloropropane	
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride	↓	124-48-1	Dibromochloromethane	
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloromethane		100-42-5	Styrene	
	2-Pentanone	↓		Total Xylenes	↓

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 3 (Hogum Cr 32)
Tag Number: 8-15601
Sample Matrix: AQUEOUS

Case number: AMBIENT / EFFLUENT
Site: BLACKFOOT RIVER
Date Received: 4-24-89
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 4-27-89
Date Analyzed: 4-27-89
Conc Factor: 1
Units: ug/L

MS File: BF9
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloroethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane		78-87-5	1,2-Dichloropropane	
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride		124-48-1	Dibromochloromethane	
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloromethane		100-42-5	Styrene	
	2-Pentanone			Total Xylenes	

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 7 HELMVILLE MT 12/2/88
Tag Number: 8-15608
Sample Matrix: AQUEOUS

Case number: AMBIENT / EFFLUENT
Site: BLACKFOOT RIVER
Date Received: 4-24-89
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 4-27-89
Date Analyzed: 4-27-89
Conc Factor: 1
Units: ug/l

MS File: BF8
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloromethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane		78-87-5	1,2-Dichloropropane	
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride		124-48-1	Dibromochloromethane	
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloromethane		100-42-5	Styrene	
	2-Pentanone			Total Xylenes	

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 11 ROUNDUP 882 88
Tag Number: 8-15604
Sample Matrix: AQUEOUS

Case number: AMBIENT/EFFLUENT
Site: BLACKFOOT RIVER
Date Received: 4-24-89
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 4-27-89
Date Analyzed: 4-27-89
Conc Factor: 1
Units: ug/l

MS File: BF7
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloroethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane		78-87-5	1,2-Dichloropropane	
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride		124-48-1	Dibromochloroethane	
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloroethane		100-42-5	Styrene	
	2-Pentanone			Total Xylenes	

QC: ALTHOUGH THE D4-1,2-DICHLOROETHANE SURROGATE RECOVERY WAS ABOVE THE 3σ ACCEPTANCE LIMITS, NO COMPOUNDS WERE DETECTED AND THE < VALUES SHOULD BE VALID.

Organics Analysis Data Sheet

Laboratory Name: USEPA Region 8
Lab Sample ID: STATION 14 AT USGS STATION
Tag Number: 8-15967
Sample Matrix: AQUEOUS

Case number: AMBIENT/EFFLUENT
Site: BLACKFOOT RIVER
Date Received: 4-24-89
Data Released By: A. Curtis

Volatile Compounds

Concentration: L,M,H LOW
Date Extracted/Prepared: 4-27-89
Date Analyzed: 4-27-89
Conc Factor: 1
Units: ug/l

MS File: BF2
Percent Moisture: —
pH: —
Dil Factor: —

CAS#	Compound Name	Amount	CAS#	Compound Name	Amount
74-87-3	Chloromethane	< 2	79-34-5	1,1,2,2-Tetrachloroethane	< 2
74-83-9	Bromomethane		78-87-5	1,2-Dichloropropane	
75-01-4	Vinyl Chloride		10061-02-6	Trans-1,3-Dichloropropene	
75-00-3	Chloroethane		79-01-6	Trichloroethene	
75-09-2	Methylene Chloride		124-48-1	Dibromochloromethane	
67-64-1	Acetone	< 10	79-00-5	1,1,2-Trichloroethane	
75-15-0	Carbon Disulfide	< 2	71-43-2	Benzene	
75-35-4	1,1-Dichloroethene		10061-01-5	Cis-1,3-Dichloropropene	
75-34-3	1,1-Dichloroethane		110-75-8	2-Chloroethylvinylether	
156-60-5	Trans-1,2-Dichloroethene		75-25-2	Bromoform	
67-66-3	Chloroform		591-78-6	2-Hexanone	
107-06-2	1,2-Dichloroethane		108-10-1	4-Methyl-2-Pentanone	
78-93-3	2-Butanone		127-18-4	Tetrachloroethene	
71-55-6	1,1,1-Trichloroethane		108-88-3	Toluene	
56-23-5	Carbon Tetrachloride		108-90-7	Chlorobenzene	
108-05-4	Vinyl Acetate		100-41-4	Ethylbenzene	
75-27-4	Bromodichloromethane		100-42-5	Styrene	
	2-Pentanone			Total Xylenes	

PROJECT : BLACKFOOT RIVER BIOASSAY DATE : 4-27-89

SUBSTRATE : AQUEOUS

SPIKE LEVEL : 20 ug/l

VOLATILES

GC/MS FILE	SAMPLE	TAG #	% RECOVERY 1,2-DICHLORO-ETHANE-D4	D8-TOLUENE	COMMENTS
BF4	LAB BLANK 4-27-89	—	94.1	118	—
BF2	STATION 14	8-15967	84.8	85.2	—
BF7	STATION 11	8-15604	*140	110	—
BF8	STATION 7	8-15608	107	81.3	—
BF9	STATION 3	8-15601	110	81.4	—
	CUSUM	$\bar{p}$	101	100	
	DATA	S.D.	11.0	10.4	
	BASE	$\bar{p} \pm 2$ SD	79.4-123	79.2-121	
		$\bar{p} \pm 3$ SD	68.5-134	68.8-131	
		# OF DATA POINTS	562	549	

* = OUTSIDE THE 99% (3σ) CONFIDENCE LIMITS.

ALL OTHER RECOVERIES WERE WITHIN THE 95% (2σ) CONFIDENCE LIMITS.

ORGANIC LAB RESULTS

USEPA REGION 8

Date: 5-9-89

Analyst: JOHN W. MARSHALL

Case #: Black Foot River

Location: BLACKFOOT RIVER

Date Sampled: 4-24-89

Date Analyzed:

Sample Matrix: Water

Parameters: Semi-volatiles

Sample ID: 8-15610, 8-15603, 8-15606, 8-15969

Sample Size: 1 liter

Final Volume: 1ml

Extraction Method: EPA Method 625

Instrument: Incos 50

Detector: MS

Column: SE 54-5

Temperature: programmed

Flows: ~30 cm/sec

Injection Size: ~2ul

Comments:

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

(14)

EPA SAMPLE NO.

8-15969
Blackfoot River

USGS STATION

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-15969

Sample wt/vol: _____ (g/mL) ____ Lab File ID: 70248

Level: (low/med) _____ Date Received: 4-26-89

% Moisture: not dec. _____ dec. _____ Date Extracted: 4-27-89

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: 1 liter ⇒ 1ml

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene		

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

8-15969 Blackfoot River

Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
99-09-2	3-Nitroaniline	10	U
83-32-9	Acenaphthene		
51-28-5	2,4-Dinitrophenol		
100-02-7	4-Nitrophenol		
132-64-9	Dibenzofuran		
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate		
117-84-0	Di-n-octylphthalate		
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

8-15969
Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

Number TICs found: _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
2.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET (11)

EPA SAMPLE NO.

8-15603
Rudyard River

Lab Name: EPA Region VIII Contract: ROUNDUP BAR RE

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-15603

Sample wt/vol: _____ (g/mL) ____ Lab File ID: 70250

Level: (low/med) _____ Date Received: 4-26-89

% Moisture: not dec. _____ dec. _____ Date Extracted: 4-27-89

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: Water 1:1 ml

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene	✓	

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

8-15603
Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND		Q
99-09-2	3-Nitroaniline	10	U
83-32-9	Acenaphthene		
51-28-5	2,4-Dinitrophenol		
100-02-7	4-Nitrophenol		
132-64-9	Dibenzofuran		
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate	5.2	
117-84-0	Di-n-octylphthalate	10	U
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

8-15603
Hackett River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

Number TICs found: _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
2.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

8-15610
Blackfoot Brook

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-15610

Sample wt/vol: _____ (g/mL) ____ Lab File ID: 70249

Level: (low/med) _____ Date Received: 4-26-89

% Moisture: not dec. _____ dec. _____ Date Extracted: 4-27-89

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: Water → 1ml

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene		

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

8-15610

Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS: (ug/L or ug/Kg) _____

CAS NO.	COMPOUND	(ug/L or ug/Kg)	Q
99-09-2	3-Nitroaniline	10	U
83-32-9	Acenaphthene		
51-28-5	2,4-Dinitrophenol		
100-02-7	4-Nitrophenol		
132-64-9	Dibenzofuran		
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate		
117-84-0	Di-n-octylphthalate		
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

8-15610
Black Foot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

Number TICs found: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
2.				
3.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

8-15606
Blackfoot River

Lab Name: EPA Region VIII Contract: (17) HELMVILLE 5210WE

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-15606

Sample wt/vol: _____ (g/mL) ____ Lab File ID: 70253

Level: (low/med) _____ Date Received: 4-26-89

% Moisture: not dec. _____ dec. _____ Date Extracted: 4-27-89

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: Water → 1ml

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene	√	

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

8-15-06 Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
99-09-2	3-Nitroaniline	10	U
83-32-9	Acenaphthene		
51-28-5	2,4-Dinitrophenol		
100-02-7	4-Nitrophenol		
132-64-9	Dibenzofuran		
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate	4.3	
117-84-0	Di-n-octylphthalate	10	U
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

8-15606, Hackett River

Lab Name: EPA Region III Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

Number TICs found: _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
2.				
3.				
4.				
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Blank Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: Blank

Sample wt/vol: _____ (g/mL) _____ Lab File ID: 70247

Level: (low/med) _____ Date Received: 4-26-89

% Moisture: not dec. _____ dec. _____ Date Extracted: 4-27-89

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: 1 liter → 1ml

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
108-95-2	Phenol	10	U
111-44-4	bis(2-Chloroethyl)ether		
95-57-8	2-Chlorophenol		
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene		
100-51-6	Benzyl alcohol		
95-50-1	1,2-Dichlorobenzene		
95-48-7	2-Methylphenol		
108-60-1	bis-(2-Chloroisopropyl)ether		
106-44-5	4-Methylphenol		
621-64-7	N-Nitroso-di-n-propylamine		
67-72-1	Hexachloroethane		
98-95-3	Nitrobenzene		
78-59-1	Isophorone		
88-75-5	2-Nitrophenol		
105-67-9	2,4-Dimethylphenol		
65-85-0	Benzoic acid		
111-91-1	bis(2-Chloroethoxy)methane		
120-83-2	2,4-Dichlorophenol		
120-82-1	1,2,4-Trichlorobenzene		
91-20-31	Naphthalene		
106-47-8	4-Chloroaniline		
87-68-3	Hexachlorobutadiene		
59-50-7	4-Chloro-3-methylphenol		
91-57-6	2-Methylnaphthalene		
77-47-4	Hexachlorocyclopentadiene		
88-06-2	2,4,6-Trichlorophenol		
95-95-4	2,4,5-Trichlorophenol		
91-58-7	2-Chloronaphthalene		
88-74-4	2-Nitroaniline		
131-11-3	Dimethylphthalate		
208-96-8	Acenaphthylene		
606-20-2	2,6-Dinitrotoluene		

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

Blank Blodgett River

1 Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg)	Q
99-09-2	3-Nitroaniline	10	U
83-32-9	Acenaphthene		
51-28-5	2,4-Dinitrophenol		
100-02-7	4-Nitrophenol		
132-64-9	Dibenzofuran		
121-14-2	2,4-Dinitrotoluene		
84-66-2	Diethylphthalate		
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol		
85-01-8	Phenanthrene		
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene		
85-68-7	Butylbenzylphthalate		
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate		
117-84-0	Di-n-octylphthalate		
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

Blank
Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-2-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

Number TICs found: _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
8-15610 Matrix Spike
Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: 8-15610 MS

Sample wt/vol: _____ (g/mL) ____ Lab File ID: 70254

Level: (low/med) _____ Date Received: 4-26-89

% Moisture: not dec. _____ dec. _____ Date Extracted: 4-27-89

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-3-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: 1 liter → 1 ml

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

CAS NO.	COMPOUND			Q
108-95-2	Phenol	MS	41.1	
111-44-4	bis(2-Chloroethyl)ether		10	U
95-57-8	2-Chlorophenol	MS	25.9	
541-73-1	1,3-Dichlorobenzene		10	U
106-46-7	1,4-Dichlorobenzene	MS	25.8	
100-51-6	Benzyl alcohol		10	U
95-50-1	1,2-Dichlorobenzene			
95-48-7	2-Methylphenol			
108-60-1	bis-(2-Chloroisopropyl)ether			
106-44-5	4-Methylphenol			
621-64-7	N-Nitroso-di-n-propylamine	MS	23.1	
67-72-1	Hexachloroethane		10	U
98-95-3	Nitrobenzene			
78-59-1	Isophorone			
88-75-5	2-Nitrophenol			
105-67-9	2,4-Dimethylphenol			
65-85-0	Benzoic acid			
111-91-1	bis(2-Chloroethoxy)methane			
120-83-2	2,4-Dichlorophenol			
120-82-1	1,2,4-Trichlorobenzene	MS	25.7	
91-20-31	Naphthalene		10	U
106-47-8	4-Chloroaniline			
87-68-3	Hexachlorobutadiene			
59-50-7	4-Chloro-3-methylphenol	MS	50.6	
91-57-6	2-Methylnaphthalene		10	U
77-47-4	Hexachlorocyclopentadiene			
88-06-2	2,4,6-Trichlorophenol			
95-95-4	2,4,5-Trichlorophenol			
91-58-7	2-Chloronaphthalene			
88-74-4	2-Nitroaniline			
131-11-3	Dimethylphthalate			
208-96-8	Acenaphthylene			
606-20-2	2,6-Dinitrotoluene			

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
Matrix
8-15610. Soil
Blackfoot River

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) ____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-3-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) _____	Q
99-09-2	3-Nitroaniline	10	U
83-32-9	Acenaphthene MS	31.0	
51-28-5	2,4-Dinitrophenol	10	U
100-02-7	4-Nitrophenol MS	5.2	
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene MS	27.2	
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether		
86-73-7	Fluorene		
100-01-6	4-Nitroaniline		
534-52-1	4,6-Dinitro-2-methylphenol		
86-30-6	N-Nitrosodiphenylamine (1)		
101-55-3	4-Bromophenyl-phenylether		
118-74-1	Hexachlorobenzene		
87-86-5	Pentachlorophenol MS	50.7	
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene		
84-74-2	Di-n-butylphthalate		
206-44-0	Fluoranthene		
129-00-0	Pyrene MS	65.3	
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine		
56-55-3	Benzo(a)anthracene		
218-01-9	Chrysene		
117-81-7	bis(2-Ethylhexyl)phthalate MS	26.1	
117-84-0	Di-n-octylphthalate	10	U
205-99-2	Benzo(b)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
50-32-8	Benzo(a)pyrene		
193-39-5	Indeno(1,2,3-cd)pyrene		
53-70-3	Dibenz(a,h)anthracene		
191-24-2	Benzo(g,h,i)perylene		

(1) - Cannot be separated from diphenylamine

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
8-15610 Spike
Blank Spike Dup

Lab Name: EBA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) _____ Lab Sample ID: _____

Sample wt/vol: _____ (g/mL) _____ Lab File ID: _____

Level: (low/med) _____ Date Received: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: _____

Extraction: (SepF/Cont/Sonc) _____ Date Analyzed: 5-3-89

GPC Cleanup: (Y/N) ___ pH: ____ Dilution Factor: _____

CONCENTRATION UNITS:
(ug/L or ug/Kg) _____

Number TICs found: _____

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	None			
2.				
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2C
WATER SEMIVOLATILE SURROGATE RECOVERY

Lab Name: EPA Region VII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Blackfoot River Survey May 1989

	EPA SAMPLE NO.	S1 (NBZ) #	S2 (FBP) #	S3 (QUI)#	S4 (PHL) #	S5 (2FP) #	S6 (TBP) #	OTHER	TOT OUT
01	8-15606	53.6	71.8	N/A	42.8	48.6	79.6		
02	8-15603	63.8	77.6		45.6	66.4	101.8		
03	8-15610	65.0	78.8		49.4	63.2	112.6		
04	8-15969	65.8	63.2		45.0	51.2	118.6		
05	Blank	78.2	79.4		56.4	61.0	87.4		
06	8-15610 MS	55.0	61.8		43.8	49.0	91.2		
07									
08									
09									
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		QC LIMITS
S1 (NBZ)	= Nitrobenzene-d5	(35-114)
S2 (FBP)	= 2-Fluorobiphenyl	(43-116)
S3 (TPH)	= QUINOXALINE	(33-141)
S4 (PHL)	= Phenol-d5	(10-94)
S5 (2FP)	= 2-Fluorophenol	(21-100)
S6 (TBP)	= 2,4,6-Tribromophenol	(10-123)

Column to be used to flag recovery values with an asterisk

* Values outside of contract required QC limits

3C

WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: EPA Region VIII Contract: _____

Lab Code: _____ Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - EPA Sample No.: _____ Blackfoot River 8-15610

COMPOUND	AMOUNT ADDED (~~mg/kg~~ 50 ug/ml)	SAMPLE CONC. IN EXTRACT (ug/L)	MS CONC. IN EXTRACT (ug/L)	MS% REC #	QC LIMITS REC.
Phenol			41.1	82.2	12-89
2-Chlorophenol			25.9	51.8	27-123
1,4-Dichloro-benzene			25.8	51.6	36-97
N-Nitroso-di-n-Propylamine			23.1	46.2	41-116
1,2,4-Trichloro-benzene			25.7	51.4	39-98
4-Chloro-3-Methyl-phenol			50.6	101.2	23-97
Acenaphthene			31.0	62.0	46-118
4-Nitrophenol			5.2	10.4	10-80
2,4-Dinitrotoluene			27.2	54.4	24-96
Pentachlorophenol			50.7	101.4	9-103
Pyrene			65.3	130.6	26-127

COMPOUND	MSD CONC. IN EXTRACT (ug/L)	MSD% REC #	MS% REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol					42	12-89
2-Chlorophenol					40	27-123
1,4-Dichloro-benzene					28	36-97
N-Nitroso-di-n-Propylamine					38	41-116
1,2,4-Trichloro-benzene					28	39-98
4-Chloro-3-Methyl-phenol					42	23-97
Acenaphthene					31	46-118
4-Nitrophenol					50	10-80
2,4-Dinitrotoluene					38	24-96
Pentachlorophenol					50	9-103
Pyrene					31	26-127

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: _____ out of _____ outside limits

Spike Recovery: _____ out of _____ outside limits

COMMENTS: _____